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Original

LITIGATION TECHNICAL SUPPORT AND SERVICES

ROCKY MOUNTAIN ARSENAL

FINAL
TECHNICAL PLAN
FEBRUARY 1986

TASK NO. 7
PHASE I SURVEY OF LOWER LAKES AREA
CONTRACT NO DAAK11-84-D-0017

EBASCO SERVICES INCORPORATED
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PREPARED FOR

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**PROGRAM MANAGER'S
OFFICE FOR
ROCKY MOUNTAIN ARSENAL CLEANUP**



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13. ABSTRACT (Maximum 200 words) <p>THE OBJECTIVE OF THIS TASK IS TO CONDUCT CONTAMINATION SURVEYS OF THE LOWER LAKES AREA WHICH INCLUDES LAKES LADORA AND MARY, UNCONTAMINATED AREAS OF SECTIONS 1 AND 2, AND DRAINAGE DITCHES 1-1 AND 2-1 FROM THE SOUTH PLANTS AREA. THE CONTAMINATION SURVEYS ARE DESIGNED TO 1) ASSESS THE DEGREE AND TYPES OF CONTAMINATION IN THE UNSATURATED ZONE WITHIN THE AREA AND 2) SUPPORT THE DEVELOPMENT AND ASSESSMENT OF FEASIBLE REMEDIAL ACTIONS. THIS IS A PHASE I INVESTIGATION AND WILL FOCUS ON THE SOURCES OF CONTAMINATION RATHER THAN CONTAMINANT PATHWAYS.</p> <p>SECTIONS OF THIS PLAN DETAIL INFORMATION ON THE FOLLOWING PROGRAMS:</p> <ol style="list-style-type: none"> 1. FIELD SAMPLING 2. CHEMICAL ANALYSIS 3. QUALITY ASSURANCE 4. HEALTH AND SAFETY 5. DATA COMPILATION AND MANAGEMENT. 				
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THE VIEWS, OPINIONS, AND/OR FINDINGS CONTAINED IN THIS REPORT ARE THOSE OF THE AUTHOR(S) AND SHOULD NOT BE CONSTRUED AS AN OFFICIAL DEPARTMENT OF THE ARMY POSITION, POLICY, OR DECISION, UNLESS SO DESIGNATED BY OTHER DOCUMENTATION.

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SECTION 1

1.0 INTRODUCTION

1.1 Background

The Program Manager's Office (PMO) for Rocky Mountain Arsenal Cleanup is overseeing efforts by two contractor teams to identify the contamination present on Rocky Mountain Arsenal (RMA). This Technical Plan describes the work that the contractor team headed by Ebasco Services Incorporated will undertake to survey conditions at locations at RMA generally defined as the Lower Lakes Area.

This Plan is one of a series that has been and will continue to be proposed by Ebasco to describe its planned activities at RMA. Ebasco's Final Technical Plan for Task No. 2, South Plants (Ebasco, 1985a) was the first of these Plans and is a reference document for all plans subsequently generated. The South Plants Technical Plan contains detailed background information on the general contamination problems at RMA and for this reason is routinely referenced by this Lower Lakes Plan.

The objective of this Task and Task 12 is to conduct contamination surveys for the Lower Lakes area. Task 7 includes Lakes Ladora and Mary, uncontaminated areas of Sections 1 and 2 and drainage ditches 1-1 and 2-1 from the South Plants area. Task 12 includes a number of other sites in the Lower Lakes area including Upper and Lower Derby Lakes, Upper Derby Lake Overflow and Rod and Gun Club Pond. The contamination surveys are designed to assess the degree and types of contamination in the unsaturated zone within the Lower Lakes area and to support the development and assessment of feasible remedial actions.

The Lower Lakes Contamination Survey Task is a Phase I investigation. Data resulting from this Task will allow Ebasco and PMO to plan further field investigations which will be of the Phase II type. These Phase II investigations will yield data that will make it possible to quantify and specifically locate the various contaminants present at RMA. All Phase II investigations will be conducted as a separate PMO Task and will be the subject of another Technical Plan.

1.2 Technical Approach

1.2.1 Phase I

Although groundwater has been determined to be the principal pathway for contamination from RMA and Shell Chemical Company (SCC) facilities, Task 7 will focus on the sources of contamination rather than contaminant pathways. Consequently, the activities to be conducted will consist primarily of the collection of soil and sediment samples and the chemical analysis of the samples. Soil samples will usually be collected from the unsaturated zone extending from land surface down to the local water table. Lake sediment samples will be collected from the lake bottom through the lake sediment.

Sections 2 through 8 of this Technical Plan describe the specific activities to be performed in Task 7. A separate document, Rocky Mountain Arsenal Procedures Manual to the Technical Plan, Volumes I-IV (RMA Procedures Manual), describes the procedures to be used in accomplishing these activities, including sampling and sample-handling procedures, project specific analytical methods, health and safety procedures and quality assurance procedures (Ebasco 1985b). A separate Damage Assessment Report (DAR) (Ebasco 1985c), which is privileged and confidential, describes physical, environmental, historical, and other pertinent information about each of the study areas.

1.2.2 Phase II

Results of the Phase I studies will be used to develop a Phase II program, which will be part of a subsequent task. Phase II will be designed to more accurately define the degree and geometry of contamination present at the sites. The severity and significance of contamination will be assessed according to criteria developed by a separate joint group of experts designated by PMO. In a parallel effort, Ebasco will identify feasible remedial action alternatives and assess their cost-benefit implications. Based on these and other considerations, final remedial action measures will be determined.

1.3 Sites To Be Investigated Under Task 7

1.3.1 Locations of Sites

The locations of sites to be investigated are shown on Figure 1.3-1. A listing of the sites is given below.

<u>Source</u>	<u>Name</u>	<u>Approx. Area (Sq. Ft.)</u>
1-1	Drainage ditches	115,200 (176,000)*
1-9	Open storage area	565,000
2-1	Drainage ditches	177,600 (480,000)*
2-17	Ladora Lake and Lake Mary	3,142,000
3-2	Drainage ditch	3,480
3-3	Overflow basin	27,000
3-4 ¹	Nemagon spill area	28,800 (276,000)*
24-6	Sewage treatment plant soil, pond	172,000 (320,000)*
30-4	Sanitary landfill	208,000 (400,000)*
Section 1	Uncontaminated area	14,000,000
Section 2	Uncontaminated area	19,000,000

All of these sites were identified from historical data and were classified by PMO and D'Appolonia Consulting Engineers in a 1984 report (RMACCPMT, 1984) as 'potentially contaminated' sites and 'balance of the sites investigated.' Site 1-9 was identified as such in one part of this report but not in another. Examination of the literature during the preparation of the Task 7 DAR brought to light four separate spill incidents in Site 1-9. Therefore, it has been included in Task 7.

The sizes of 5 of the areas to be investigated have been increased beyond that shown in the PMO and D'Appolonia report: Site 1-1, drainage ditches, has been increased by 60,800 square feet to a total of 176,000

*Areal extent of site expanded for evaluation purposes because of information that became available during subsequent literature search.

LEGEND

UNCONTAMINATED AREAS

Uncontaminated Areas in
Section 1

Uncontaminated Areas in
Section 2

CONTAMINATED AREAS

Source 1-1

Source 1-9

Source 2-1

Source 2-17

Source 3-2

Source 3-3

Source 24-6

Source 30-4

Source 3-4
Nemagon Spill Areas

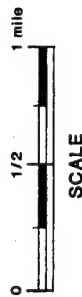
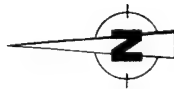
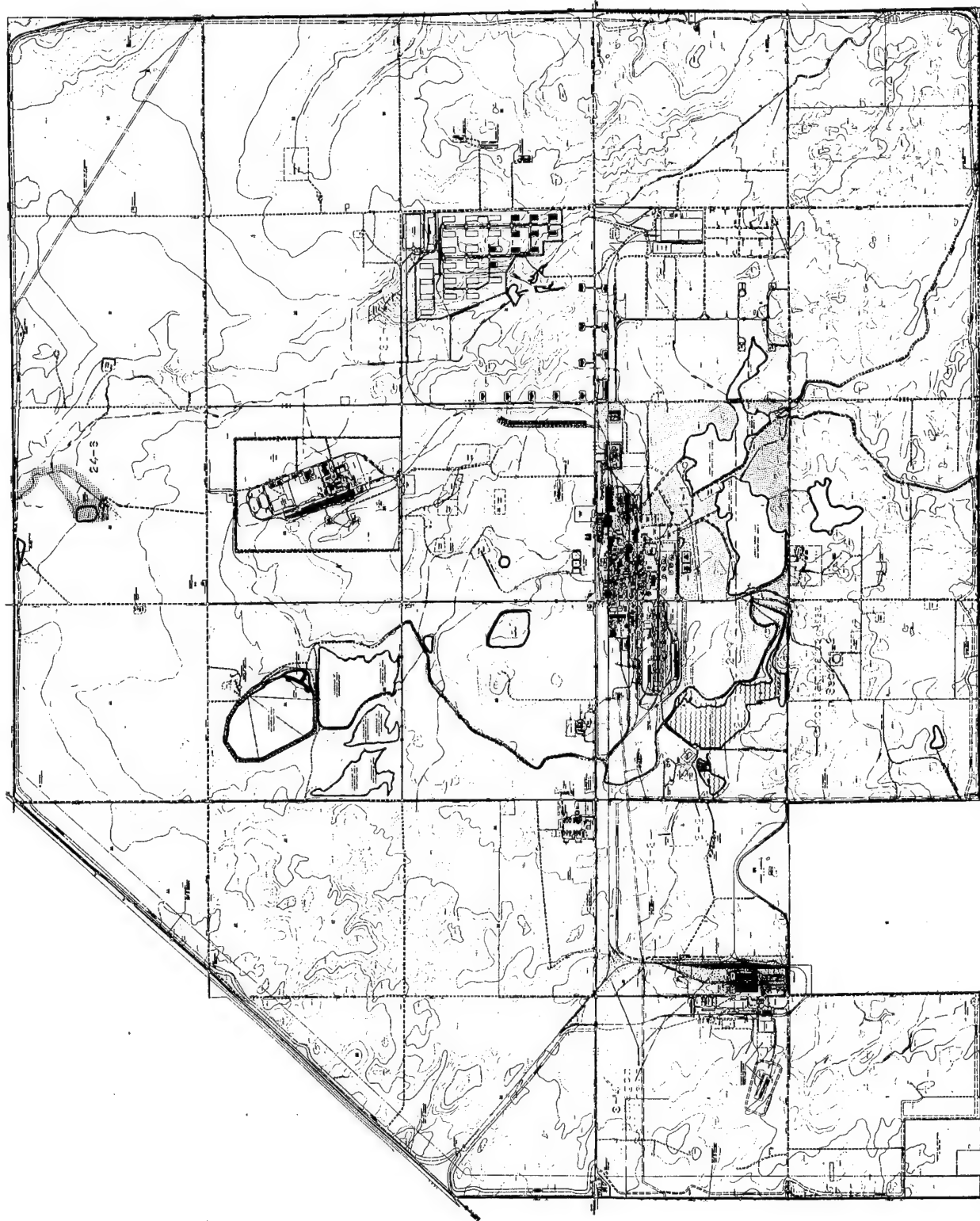


FIGURE 1.3-1

LOCATIONS OF STUDY AREAS
UNDER TASK 7

square feet; Site 2-1, drainage ditches, by 302,400 square feet to a total of 480,000 square feet; Site 3-4', Nemagon spill, by 247,200 square feet to a total of 276,000 square feet; Site 24-6, sewage treatment plant, by 148,000 square feet to a total of 320,000 square feet; and Site 30-4, sanitary landfill, by 192,000 square feet to a total of 400,000 square feet. The reasons are as follows. In the cases of Sites 1-1 and 2-1, Geraghty and Miller, in preparing the DAR for the South Plants area, found that the drainage ditches extending southeast and southwest from the South Plants area and draining into the Derby Lakes and the Sand Creek Lateral, respectively, had received contaminated waste, including chlorinated hydrocarbons. Geraghty and Miller, therefore, included these drainage ditches in Sites 1-1 and 2-1. In the case of Site 3-4', review of the literature indicated that spills could have occurred anywhere in the railroad classification yard and along the tracks entering and exiting the yard. Therefore, the site has been expanded to include the north-south tracks of the railroad yard to the northern and southern boundaries of Section 3 and redesignated site 3-4'. In the case of Site 24-6, a review of the literature indicated that Nemagon-contaminated effluent from the sewage treatment plant had flowed into the pond and, from the pond and the plant, down two drainage ditches into First Creek. Therefore, these drainage ditches have been included in the site. In the case of Site 30-4, a review of the literature has indicated that an older landfill exists contiguous to the present landfill and southeast of it. This older landfill has been included in the site.

Limited investigations of Site 1-9 and Site 3-4' have previously been conducted. These investigations have been considered in the development of this Technical Plan.

The final sizes of the sites to be investigated are shown on the above list in parentheses adjacent to the original sizes.

1.3.2 Location of Buildings

Buildings in the study areas are listed in Table 1.3-1. None of these buildings was leased to or used by SCC. They will not be investigated in Task 7.

TABLE 1.3-1
BUILDINGS IN TASK 7 STUDY AREAS

Source Area	Building Number	Source	Building Number
1-1	None	3-4'	611
2-1	None	3-4'	625
2-17	371	3-4'	612
3-2	None	3-4'	639
3-3	None	3-4'	626C
3-4'	379	3-4'	648A
3-4'	614	3-4'	648B
3-4'	615	3-4'	628A
3-4'	616	3-4'	629
3-4'	617	3-4'	627B
3-4'	630	3-4'	626C
3-4'	618	3-4'	627
3-4'	619	3-4'	648
3-4'	635	3-4'	647A
3-4'	T-642	3-4'	647B
3-4'	605	3-4'	647C
3-4'	606	3-4'	647D
3-4'	607	3-4'	629
3-4'	608	3-4'	629E
3-4'	621	3-4'	673
3-4'	621A	24-6	391
3-4'	622	30-4	None
3-4'	633B	Section 1	None
3-4'	633	Section 2	374
3-4'	634	Section 2	372
3-4'	613	Section 2	373B
3-4'	632	Section 2	383
3-4'	631	1-9	464A
3-4'	631A	1-9	464B
3-4'	624		

SECTION 2

2.0 EVALUATION OF BACKGROUND DATA

2.1 Data Compilation

2.1.1 Initial Site Reconnaissance

Members of the Ebasco team have visited RMA for an initial site reconnaissance. The purpose of these visits was to allow Ebasco team members to obtain an overview of RMA and the sites included in Task 7 by driving and walking through them. The team viewed the railroad classification yard, the sewage treatment plant, Ladora Lake and Lake Mary, the drainage ditches included in Task 7, the Lake Mary overflow basin, the open storage area, the sanitary landfill and the uncontaminated areas of Sections 1 and 2.

2.1.2 Literature Review

Following the site reconnaissance, the project team obtained and reviewed all available documents and other information pertaining to the sites. The team then prepared a Damage Assessment Report (DAR), which describes for each site the history of operations, the potential contaminants and contaminant spill or release sites, the physical environment, including the geology and hydrology, and other relevant features (Ebasco, 1985c). The DAR is privileged and confidential.

2.2 Contamination Sources

The literature review identified actual contamination sources, such as releases of aldrin and dieldrin to the Lower Lakes, as well as suspected contamination sources, such as a Nemagon spill in the rail classification yard. In some cases, the literature review indicated that some sites should be enlarged. In these instances (the Nemagon spill site, the sewage treatment site, and the landfill site), the areas have been modified to reflect the findings of the literature search. The specific sites, including any enlargements and the reasons for the enlargements, are described in Section 3.3.

SECTION 3

3.0 FIELD SAMPLING PROGRAM

3.1 Introduction

The purpose of the field sampling program will be to obtain data which will permit an assessment of the contamination in the Task 7 sites. The program will focus above the groundwater table at spill or disposal sites in Sections 3, 4, 24 and 30 and the uncontaminated areas of Sections 1 and 2. It will be conducted in two phases.

Both phases will be accomplished through soil boring programs. Phase I will consist of drilling a limited number of borings to obtain semiquantitative geochemical data to indicate whether a site is, in fact, contaminated. Phase II will consist of drilling borings to accurately define the degree and extent of contamination of the sites. Phase II will be conducted as a separate task.

Geophysical surveys will be conducted to aid in clearing sites for boring in areas where buried metal objects or underground utilities may be present.

The field sampling programs will include a health and safety survey to assess the sampling team's exposure to potential hazards during drilling and sampling.

3.1.1 Support Facilities

During the mobilization meetings at RMA held the week of October 29-November 2, 1984, the need for RMA support facilities was identified, and initial discussions were held with RMA Installation Services personnel regarding the location and establishment of such facilities. The support facilities discussed included warehouse space, office space, provision of utilities (electric power, potable water, and sewer facilities) at warehouse and office facilities, and RMA's identification of a preferred location for decontamination activities.

During subsequent meetings involving Ebasco, ESE, and RMA Facilities Engineering personnel, locations of the command center and support facilities were agreed upon. They are located along the northern boundary of Section 1, approximately 2,500 feet east of its intersection with D Street, north of Building 731 (Figure 3.1-1). RMA Facilities Engineering, with the support of Stearns-Roger, has provided hookups for electricity, potable water, and sanitary sewer facilities for the Ebasco office trailer and ESE support facilities, as well as electricity and water supplies for the existing steam cleaning area. Personnel decontamination activities and facilities are described further in the RMA Procedures Manual (Ebasco, 1985b, Volume III: Health and Safety Plan).

Heated and lighted warehouse space has been provided by RMA for the use of both Ebasco and ESE. The eastern half of Building 728 (Figure 3.1-1) has been made available for this purpose. This building has been divided in half by a firewall, and RMA has further subdivided the eastern half into three approximately equal areas by chain link fences. The central area is being used by RMA for miscellaneous equipment storage. The two outer areas will be used by Ebasco and ESE. Each of these outer areas can be accessed through separate 12-foot doors from separate loading docks on the north side of the building.

In addition to Building 728, the RMA has provided warehouse space in Building 733-C to store some of the sample cores obtained during this Task.

3.1.2 Support Activities

3.1.2.1 Topographic Surveys

Each soil boring will be surveyed to establish its elevation and map coordinates with respect to the Colorado State Planar Coordinate System. All locations will be surveyed to the nearest 0.1 foot (3 centimeters) vertically and 3 feet (1 meter) horizontally, consistent with PMO requirements.

LEGEND

EXISTING STRUCTURE

PARKING

SEC 38

STEAM
CLEANING
AREA

DECEMBER 7th AVE.

TO D STREET

PUBLIC
ENTRANCE
EXIT

ESE DECON/SUPPORT AREA

GREASE
RACK

HEAVY
EQUIPMENT
STORAGE

ARNG BUILDINGS

EBASCO COMMAND
CENTER/SUPPORT AREA

SOUTH PLANTS AREA

728

WAREHOUSE
SPACE

NOTE: SUPPORT AREAS SHOWN ARE NOT TO SCALE

APPROX. SCALE 1" = 200'



ROCKY MOUNTAIN ARSENAL
MAIN COMMAND POST AND SUPPORT FACILITY
LOCATION IN THE SOUTH PLANTS AREA

FIGURE 3.1-1

3.1.2.2 Decontamination of Equipment and Materials

Decontamination of equipment and materials will be in accordance with health and safety requirements and quality control requirements. Equipment such as boring rigs and auger flytes will be maintained and decontaminated to preclude contamination between samples and from one site to another.

Some decontamination activities will take place at the borehole locations. However, major decontamination of equipment, particularly the larger pieces of equipment, will take place at the regional steam-cleaning areas.

3.1.2.3 Waste Disposal

In accordance with EPA and PMO guidelines, all contaminated wastes, including liquids, soils, and other solid wastes, will be containerized and stored at a designated central storage area that meets RCRA requirements. The following will be handled as contaminated wastes, unless they are sampled and confirmed to be free of any contamination:

- o all soils not used for analysis purposes if they are from areas previously designated as contaminated;
- o disposable sampling gear; and
- o liquids generated at the steam-cleaning pit.

The solid materials will be placed in drums on pallets and removed to controlled disposal sites. Waste water will be placed in two 1,500 gallon tanks. When the tanks are full, the water in the tanks will be analyzed. If it is free of contaminants, it will be disposed of in the sanitary sewer. If it is contaminated, it will be removed to controlled disposal sites. Contaminated waste water disposal will be arranged by ESE.

Noncontaminated wastes will be disposed of in the sanitary sewer system or appropriate trash disposal facilities. Portable or chemical toilet wastes will be disposed of according to normal protocols.

3.1.2.4 Water Used in Geotechnical Program

For steam cleaning, decontamination and other related activities, the water used will be chlorinated city water, which is obtained from the RMA fire department's water supply.

3.2 Geophysical Program

3.2.1 Purpose

Geophysical surveys will be conducted to assure, to the extent possible, that boring locations are clear of buried metallic objects and underground utilities. Unexploded ordinance (UXO) are not expected to be present at these sites and are not a target of the geophysical program.

3.2.2 Techniques

Potentially applicable geophysical techniques have been tested for their effectiveness at RMA. These tests and their results are described in the RMA Procedures Manual (Ebasco, 1985b, Volume I, Section II).

Two geophysical methods will be used to locate buried metallic objects. They are magnetics, using a magnetic field gradiometer, and resistivity, using a "pulse induction" metal detector. The same methods will be used to detect certain kinds of buried utilities. If the utilities are within approximately five feet of the surface and are composed of ferrous (magnetic) material and/or electrically conductive material (iron, steel, aluminum, copper, etc.), they may be detectable. However, neither method will be useful in detecting and locating nonferrous and/or nonmetallic utilities. For example, some underground piping is known to consist of vitrified clay. This, as well as piping made of other, nonconductive materials, is not detectable.

3.2.3 Geophysical Surveys

Surveys for buried objects will be conducted at all borehole locations proposed for Site 30-4 (the Sanitary Landfill). Surveys for buried utilities will be conducted at borehole locations proposed for all areas included in Site 3-4' (the suspected Nemagon spill area), for Site 24-6 (the sewage treatment plant), for Sites 1-1 and 2-1 (drainage ditches), and for Site 1-9 (open storage area).

All surveys will be conducted well in advance of drilling operations to allow for an assessment of the geophysical results and relocation, if necessary, of the borehole locations.

3.3 Soil Boring Program

3.3.1 Sites to be Investigated

The sites to be investigated are shown in Figure 1.3-1.

Priorities for each site were based on the expectation of encountering contamination, as recorded in the literature. High priority sites are those which have an established record of contamination of groundwater beneath or near the site and which have few records concerning soil contamination. Low priority sites have no records of either soil or groundwater contamination but are considered potentially contaminated because of records of spills and/or waste disposal at the site. Uncontaminated sites are those at which preliminary investigation revealed no reason to suspect contamination. All sites investigated in Task 7 are considered to be high priority, except the uncontaminated areas of Sections 1 and 2.

3.3.2 Selecting Borehole Density

The general approach to the soil boring program and the method of determining borehole density were developed jointly by PMO, Ebasco, and ESE.

The vertical sampling interval and the sampling technique were developed for both the South Plants and Section 36 areas during meetings involving the contractors and PMO. The criteria developed have been applied to the other study areas where possible. However, special consideration is given to lake sampling and linear features, such as railroad tracks and ditches. In addition, some modifications will have to be made to account for actual or unexpected conditions, since in many cases the actual field conditions are unknown.

The boring spacing for areas less than two million square feet was determined utilizing the curve shown in Figure 3.3-1, which was developed empirically by members of the Ebasco and ESE teams. The total number of borings (Phase I and Phase II) was determined by dividing the area of the site by the square of the boring spacing. Then, modifications to the boring spacing at each site, as found by the curve, were made based on the priority of the site. For high priority sites, the curve was used without modification. For low priority sites, the boring spacing determined from the curve was multiplied by a factor of 1.25. For uncontaminated sites, the boring spacing was multiplied by a factor of 1.5. A grid for each boring spacing was then made and placed over the site maps to determine the boring locations.

For uncontaminated sites, additional criteria were devised. For those portions close to numerous, highly contaminated areas, a spacing of 500 feet (1 boring per 250,000 square feet) will be used. For those portions with well-defined areas of low contamination within them or surrounding them, a spacing of 750 feet will be used, or one boring per 563,000 square feet. For those portions with no known sources of contamination, a spacing of 1,000 feet will be used, or one boring per 1,000,000 square feet.

The distribution of borings between Phases I and II was determined according to an empirical scheme designed by PMO, the expert witnesses, and Ebasco and ESE. At high and low priority sites, Phase I will contain 30% of the borings and Phase II will contain 70%.

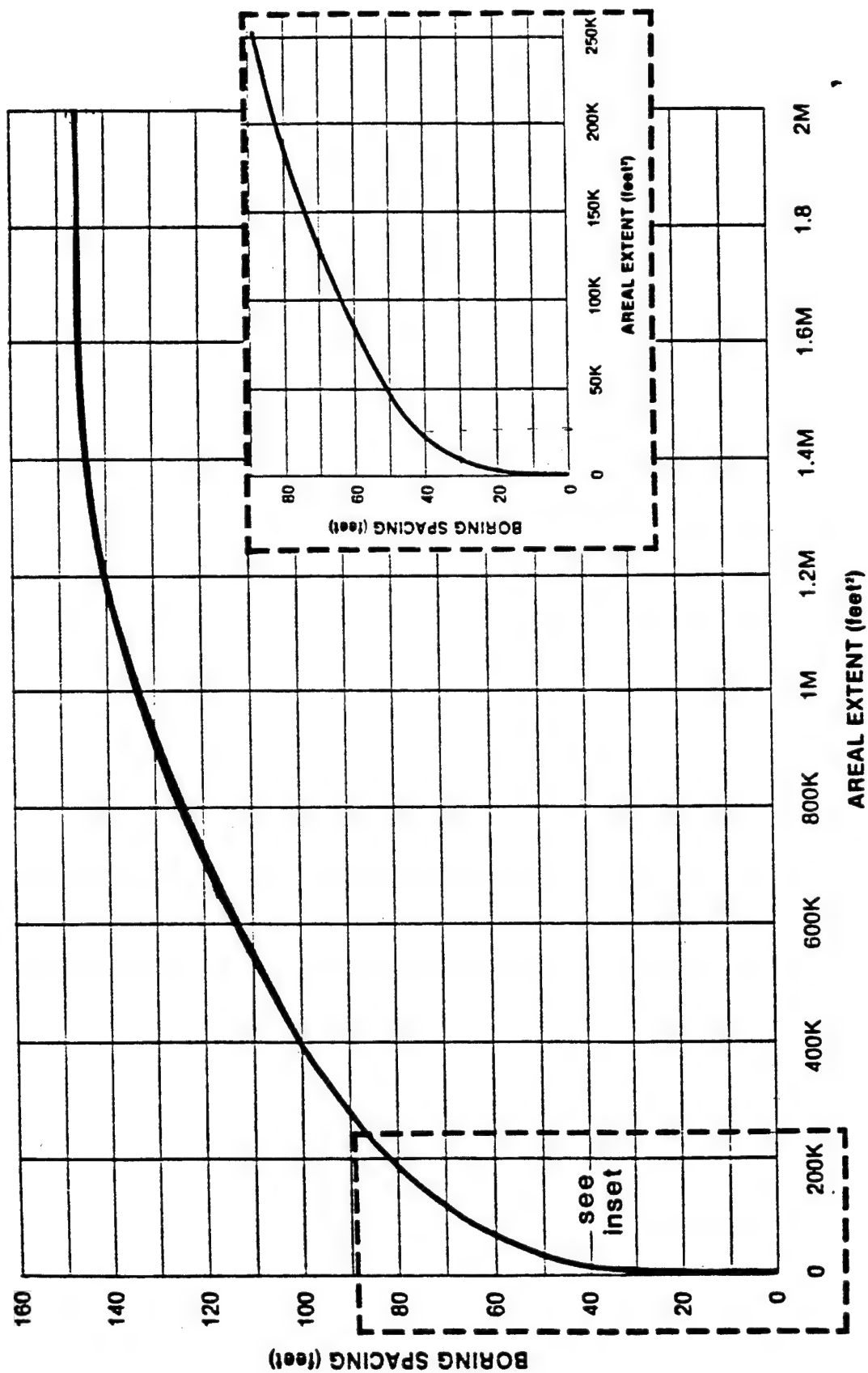


FIGURE 3.3-1

EMPIRICAL CURVE TO DETERMINE BORING SPACINGS BASED ON AREAL EXTENT OF SITES

The locations of Phase I borings are shown on the individual site maps in Section 3.3.5. Although the locations generally are evenly distributed across the sites, they are more concentrated where contamination appears likely to occur.

3.3.3 Determining Borehole Depths

The vertical sampling intervals for on-land borings are indicated in Table 3.3-1. They were established earlier in Tasks 1 and 2.

TABLE 3.3-1

Soil-Sampling Intervals (feet)	
0.0 - 1.0	
4.0 - 5.0	
9.0 - 10.0	
14.0 - 15.0	
19.0 - 20.0	
24.0 - 25.0	

Additional samples will be taken at 5-foot intervals to the water table.

In high and low priority sites, 20% of the borings will be drilled to the water table. The remaining 80% will be drilled to shallower depths within the unsaturated zone. For example, where the water table is 25 feet deep, 20% will be constructed to 5 feet above the water table, 20% will be constructed to 10 feet above the water table, 20% will be constructed to 15 feet above the water table, and 20% will be constructed to 20 feet above the water table. This empirical scheme was designed in meetings between the PMO, Ebasco, ESE, and expert consultants.

The site maps in Section 3.3.5 indicate the depths to which the borings will be drilled. Borings that extend to the water table have been located in those portions of the site that are expected to be contaminated, and the

progressively shallower borings have been located where there is expected to be less contamination. If deemed necessary, more detailed sampling will be conducted during Phase II.

In Sections 1 and 2, the uncontaminated sites, all borings will be 5 feet deep. The samples collected from 0.0 to 1.0 foot and from 4.0 to 5.0 feet will be composited into one sample at each boring.

Where there is no information as to where the contamination is within the site, all borings have been placed evenly across the site.

In the borings in Ladora Lake and Lake Mary, maximum sampling depth will be 3 feet into the sediments. The first sample will be the uppermost one foot of sediment. At half of the holes, chosen alternately on the grid pattern, a second sample will be taken which will be a composite in the 1-3 foot interval. No samples will be taken below sediments, since Phase I borings are not intended to penetrate into the water table.

3.3.4 Sampling Approach

All borings in Site 1-9, the open storage area, Site 3-4', the Nemagon spill area, Site 30-4, the sanitary landfill, and the uncontaminated areas of Sections 1 and 2, will be drilled and sampled using a continuous-core augering technique.

Five-foot cores within clear polybutyrate tubes will be obtained. Although the sampling intervals have been predetermined during Tasks 1 and 2, this method of obtaining soil cores in clear polybutyrate tubes will allow the field geologist to select samples showing obvious contamination. Detection of contamination by the geologist may involve identification of discoloration, damp areas showing contamination, or readings significantly above background on the OVA or HNU meters. Such samples will then be sent to the laboratory for chemical analysis, in addition to those from the predetermined intervals. Field measurements of volatile organics will be made during coring using OVA or HNU instruments.

Borings in areas of standing water, soggy soil conditions, or difficult access may be sampled differently. These areas may include Site 1-1 (drainage ditches), Site 2-1 (drainage ditches), Site 2-17 (Ladora Lake and Lake Mary), Site 3-2 (drainage ditch) Site 3-3 (overflow basin) and Site 24-6 (sewage treatment plant). Thorough field reconnaissance of these sites will precede boring activities, and the method of boring will be chosen at this time. Alternative methods include:

- a. Split spoon core barrel driven by a 140 lb weight attached to a motorized cathead system mounted on a sampling raft. The standard polybutyrate tubes will be placed in core barrels. This method will be used in areas of deep, standing water, such as Ladora Lake and Lake Mary.
- b. Hand-held split spoon core barrel. This method will be used in swampy or unstable soil areas where a raft will not be feasible.

Detailed descriptions of the coring and sample handling procedures can be found in the RMA Procedures Manual, (Ebasco, 1985b, Volume I).

As soon as the samples are obtained for chemical analysis, the cores will be resealed and stored. Therefore, they will be available if additional core examination is required. However, it is likely that sample holding times will have been exceeded and stored bores generally will not be analyzed.

3.3.5 Site Descriptions and Locations of Boreholes

The ten sites that will be investigated are shown in Figure 1.3-1 and described in this section. The descriptions are based on information found in the literature and compiled in the Task 7 Damage Assessment Report, which is privileged and confidential information (Ebasco, 1985c).

The accompanying maps are sketches of the sites. The first step in Phase I will be a thorough physical reconnaissance of each site and an updating of these maps. Some planned boreholes may be difficult to drill due to physical conditions, including previously unidentified power lines, cement slabs, and underground utilities, and will be relocated during the field reconnaissance.

3.3.5.1 Site 1-1, Drainage Ditches

The drainage ditches are located in the central portion of Section 1. They are approximately 8,800 feet in length and 20 feet wide, totaling 176,000 square feet. Figure 3.3-2 shows the area of study and the proposed borehole locations. The four drainage ditches collect surface-water runoff from the eastern and southern portions of the South Plants area and carry the runoff to Upper and Lower Derby Lakes. No hazardous materials are known to have been released purposely into the ditches, but accidental leakage and contaminated runoff have been reported from the South Plants area. Organic and inorganic contaminants have been identified in soil beneath the ditches. Water in the ditches contains chlorinated hydrocarbons.

The proposed boreholes are located to detect contamination sources in the South Plants area and to detect outfall values into the Upper and Lower Derby Lakes.

Groundwater levels are approximately 15 feet below the surface in this area but can be greater, depending on terrain variations.

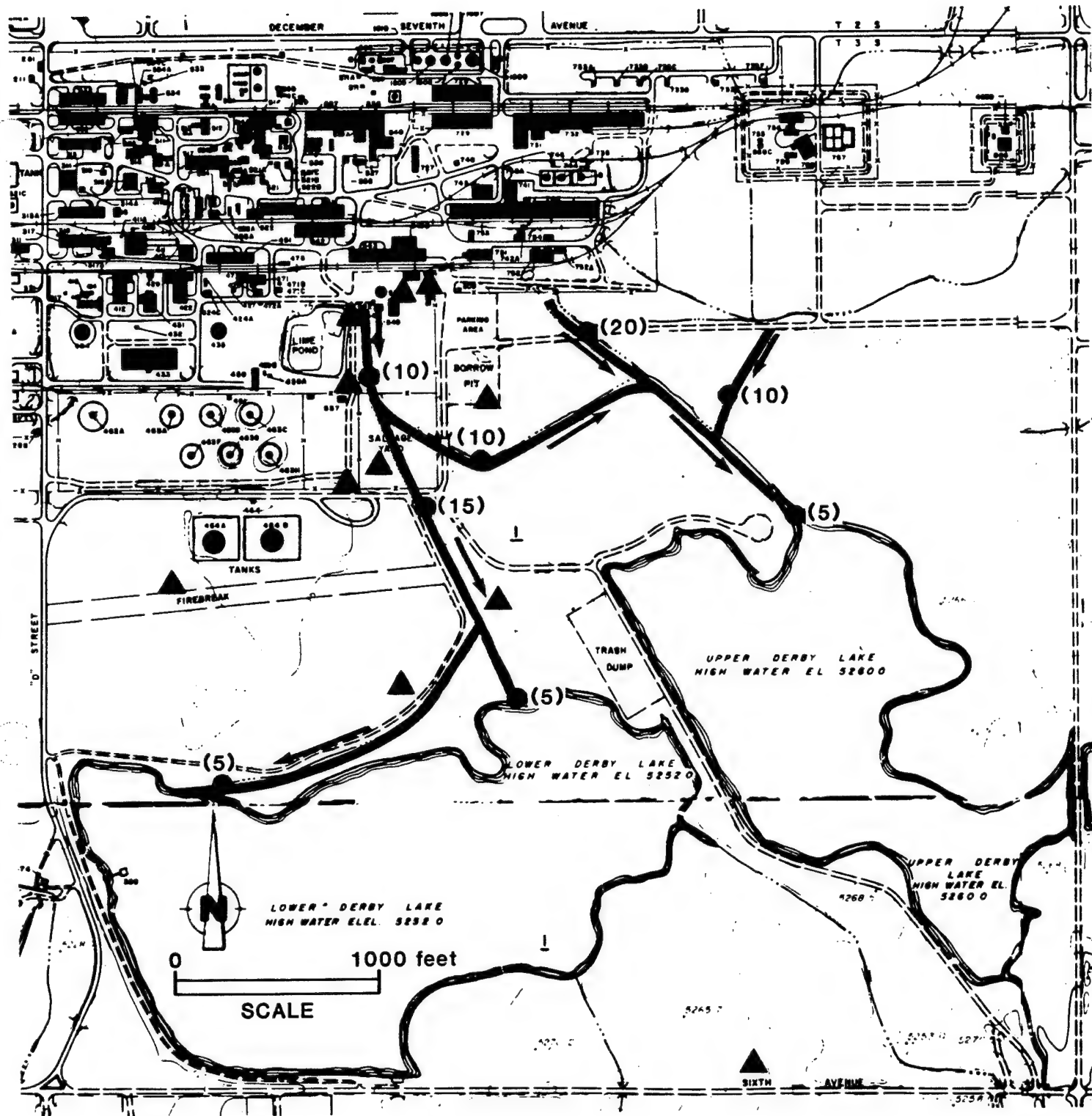
<u>Number of Phase I Borings</u>	<u>Total Depth (ft)</u>	<u>Number of Soil Samples</u>
1	20	5
1	15	4
3	10	9
3	5	6

Total Number of Borings = 8

Total Number of Samples = 24

3.3.5.2 Site 1-9, Open Storage Area

The open storage area is located immediately south of the south tank farms. It comprises approximately 565,000 square feet. Figure 3.3-3 shows the area and the proposed borehole locations. Two revetted tanks, Tank 464A and



- ▲ EXISTING BORINGS OR MONITORING WELLS
- PROPOSED BORING LOCATIONS
- (5) PROPOSED BORING DEPTH (FEET)
- DIRECTION OF SURFACE WATER FLOW

FIGURE 3.3-2
PROPOSED BORING LOCATIONS
DRAINAGE DITCHES (1-1)

Tank 464B, are located within the area and comprise approximately 180,000 square feet. The site was used as an open storage yard in 1948. The revetted tanks were installed in 1955. There is no indication that waste was disposed of at the site, but spills have been reported by Shell, and standing liquid has been observed between or near the revetted tanks on aerial photographs. The types of potential contaminants are unknown. Depth to the water table is approximately 20 feet. Fourteen borings will be drilled during Phase I.

<u>Number of Phase I Borings</u>	<u>Total Depth (ft)</u>	<u>Number of Soil Samples</u>
3	20	15
4	15	16
4	10	12
3	5	6

Total Number of Borings = 14

Total Number of Samples = 49

3.3.5.3 Site 2-1, Drainage Ditches

The drainage ditches in Section 2 are approximately 24,000 feet in length and are about 20 feet wide, totaling 480,000 square feet. Figure 3.3-4 shows the location of the ditches and the proposed borehole locations. The ditches include the major or minor runoff channels to the Sand Creek lateral, as well as the entire length of the lateral from the southeast to northwest corner of Section 2. The ditches were used to carry stormwater runoff from the South Plants area to the lateral. Although no waste is known to have been purposely disposed of in these ditches, runoff water that flows over contaminated ground in the South Plants area does enter the ditches.

The U.S. Army Engineer Waterways Experiment Station (WES) study of 1983 reported accidental drainage of storm water containing chlorinated hydrocarbons from contaminated buildings and pavements of the South Plants

area. Organic, inorganic and heavy metal contaminants have been found in the ditches. The South Plants Damage Assessment Report (privileged and confidential) lists the contaminants and their concentrations that have been sampled in the ditches. The ditches flow across outcrops of the Denver formation in the northeastern portion of Section 2. The remainder of the area is covered with alluvium. Groundwater ranges in depth from 5-10 feet below the surface in South Plants to over 30 feet below the surface in the northwestern portion of Section 2, where it may be below the alluvium - Denver Formation contact.

Borehole locations have been selected based on perceived sources of contamination in the South Plants area. No regular horizontal sampling distance was maintained for this reason.

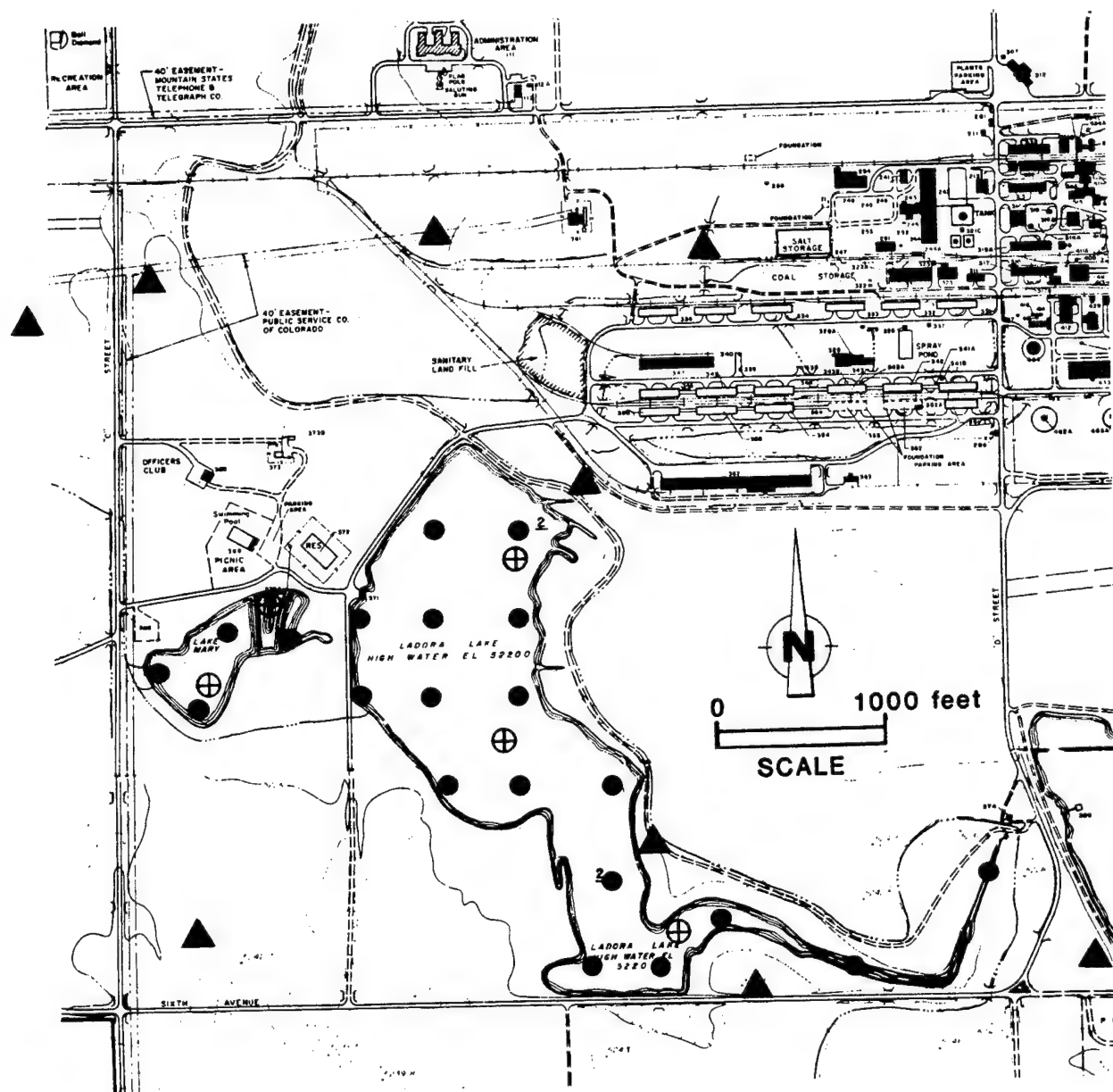
<u>Number of Phase I Borings</u>	<u>Total Depth (ft)</u>	<u>Number of Soil Samples</u>
2	20	10
4	15	16
4	10	12
5	5	8

Total Number of Borings = 15

Total Number of Samples = 46

3.3.5.4 Site 2-17, Ladora Lake and Lake Mary

Ladora Lake and Lake Mary have a combined area of 3,142,000 square feet and contain a volume of 233,000 cubic yards of water. Figure 3.3-5 shows the locations of the lakes and the proposed sampling locations for Phase I. Drainage from the South Plants area indirectly enters the lakes through Upper and Lower Derby Lakes. Ladora Lake was a source of process cooling water for industrial activities on the RMA. Lake Mary serves as an overflow area for Ladora Lake. The lakes have received contamination from the recycled cooling water, from leakage from an acetylene waste disposal basin and from accidental releases of the pesticides aldrin and dieldrin. Heavy metals and toxic organics have been detected in addition to pesticides.



- ⊕ APPROXIMATE LAKE SEDIMENT SAMPLING LOCATIONS
TAKEN BY WATERWAYS EXPERIMENTAL STATION
- ▲ EXISTING BOREHOLES
- APPROXIMATE SEDIMENT SAMPLE LOCATIONS (ALL SAMPLES WILL BE
TAKEN BETWEEN 0-3 FEET IN LAKE BED SEDIMENT)

FIGURE 3.3-5
PROPOSED LAKE SEDIMENT SAMPLING LOCATIONS
LAKES LADORA & MARY (2-17)

The edges of the lakes will be sampled by hand with a sampling device capable of obtaining a 3-foot core sample. In areas of navigable water, sampling will be conducted from a sampling raft also with a 3-foot coring device. A sample from the top foot of soil will be collected and sent to UBTL for analysis. In addition, a composite of the lake sediment sampled between 1 and 3 feet will be analyzed from every other sample location. A total of 21 locations will be sampled--4 in Lake Mary and 17 in Ladora Lake. A preliminary assumption for this sampling program was that the number of Phase I borings would be reduced by half because of the recent program of soil boring and analysis performed by WES in 1983 on these lakes.

Thirty-two soil samples will be taken. Twenty-one samples will be taken from each location at a depth of 0-1.0 foot. The additional 11 samples will be taken from 11 locations and the 1-2 foot and 2-3 foot intervals will be composited.

<u>Number of Phase I Lake Sediment Sampling</u>	<u>Total Depth (ft)</u>	<u>Number of Soil Samples</u>
21	3	32

Total Number of Lake Sediment Samples = 21

Total Number of Samples = 32

3.3.5.5 Site 3-2, Drainage Ditch and Site 3-3, Overflow Basin

The drainage ditch (3-2) extends west from Lake Mary, joins a ditch that flows from Ladora Lake, follows "C" Street north and then passes through a culvert beneath the road to the overflow basin (3-3). Figure 3.3-6 illustrates the setting and proposed borehole locations for these sites. The ditch and overflow basin cover a combined area of 30,400 square feet. The ditch and basin receive overflow from Ladora Lake and Lake Mary.

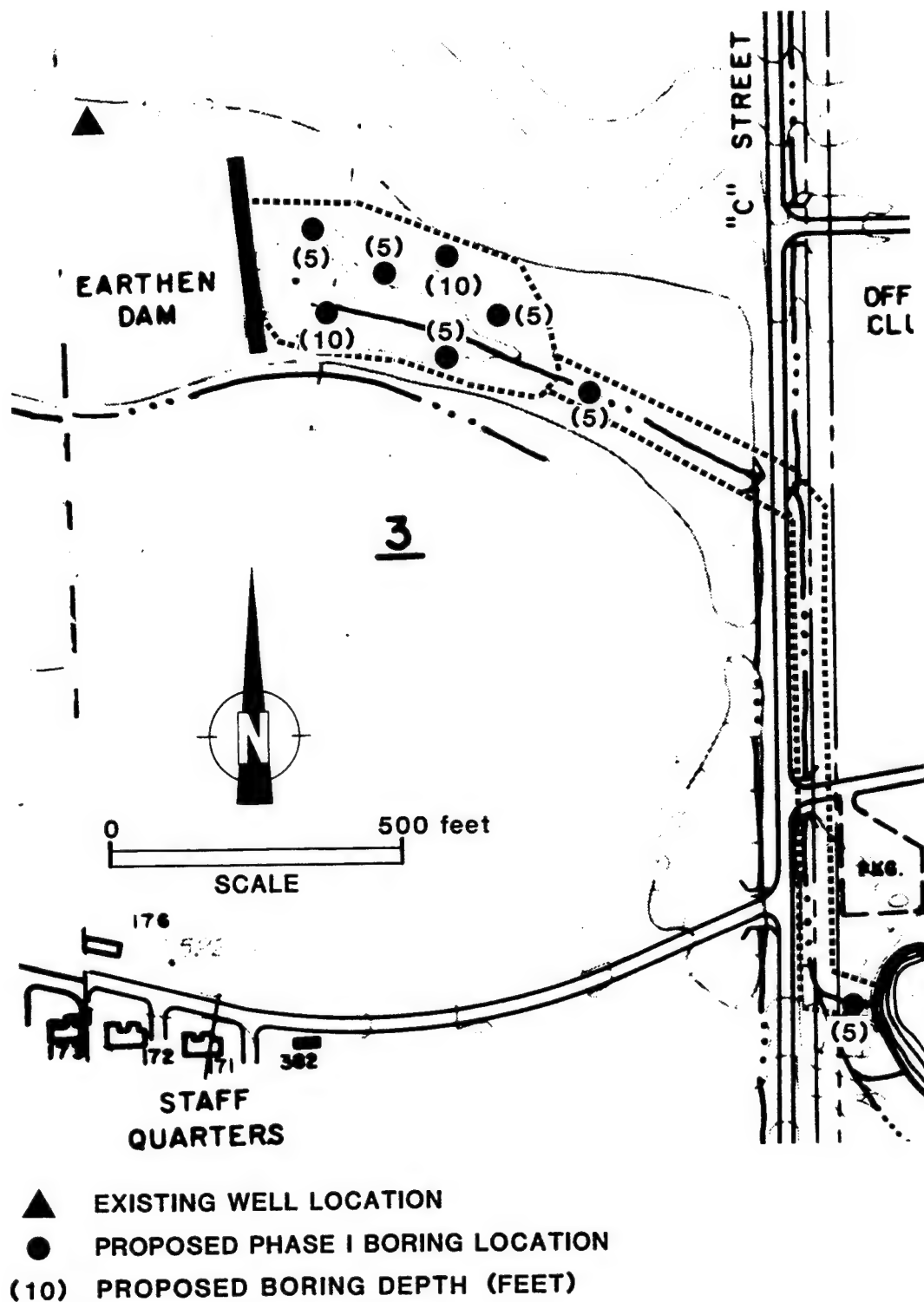


FIGURE 3.3-6
PROPOSED BORING LOCATIONS
DRAINAGE DITCH (3-2) & OVERFLOW BASIN (3-3)

The contamination of these lakes, resulting from the accidental release of pesticides and from contaminated process water, may have contributed contaminants to the ditch and basin. Low levels of aldrin, dieldrin and endrin have been detected in soils beneath these features. Groundwater depths range from 5 to 10 feet below the surface at the sites.

<u>Number of Phase I Borings</u>	<u>Total Depth (ft)</u>	<u>Number of Soil Samples</u>
2	10	6
6	5	12

Total Number of Borings = 8

Total Number of Samples = 18

3.3.5.6 Site 3-4', Nemagon Spill Area

The Nemagon spill area (Site 3-4') is located in the railroad classification yard. Figure 3.3-7 shows the yard and the proposed Phase I borehole locations.

Originally, the spill area was estimated to cover approximately 28,800 square feet. However, review of the literature indicated that spills could have occurred anywhere within the yard and along the railroad tracks entering and exiting the yard. Consequently, the site has been extended to include the north-south tracks of the railroad yard to the northern and southern boundaries of Section 3. The area to be investigated has been increased from 28,800 square feet to 276,000 square feet. Because of the linear nature of the area, the borehole spacing has been selected to be 750 feet, resulting in 10 Phase I boreholes.

Review of the literature indicated that a Nemagon spill may have occurred along the railroad tracks in the central part of Section 33. Although data from the drilling of additional water wells by WES in 1984 suggests that this apparent spill may be part of the plume from the spill in the railroad classification yard (Whitten, 1984), the presence of organic vapors in three of the WES wells indicates that it may be a separate spill.

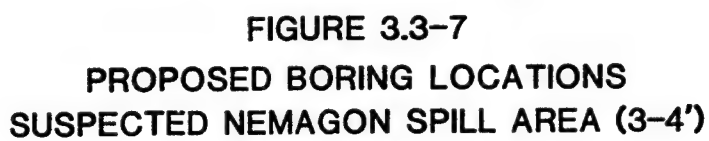


FIGURE 3.3-7
PROPOSED BORING LOCATIONS
SUSPECTED NEMAGON SPILL AREA (3-4')

As a separate task, the railroad tracks in the northeastern portion of Section 3 and in Sections 4 and 33 should be investigated for Nemagon spills.

The groundwater table is approximately 60 feet below the surface at this site.

<u>Number of Phase I Borings</u>	<u>Total Depth (ft)</u>	<u>Number of Soil Samples</u>
2	45	20
2	35	16
2	25	12
2	20	10
2	15	8

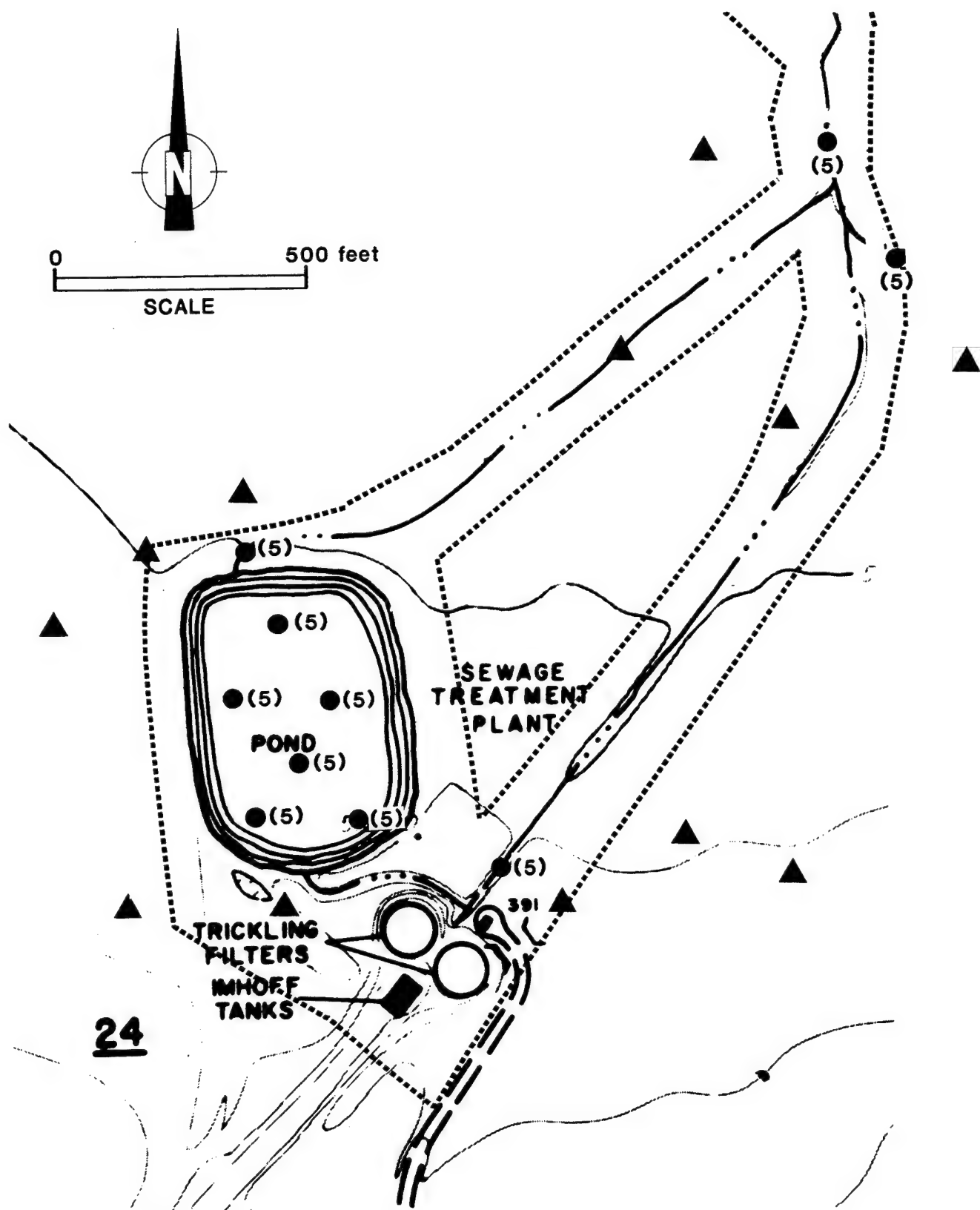
Total Number of Borings = 10

Total Number of Samples = 66

3.3.5.7 Site 24-6, Sewage Treatment Plant

The sewage treatment plant (24-6) and the adjacent evaporation pond and drainage areas have a total area of 320,000 square feet. Figure 3.3-8 shows the setting and proposed borehole locations for this site. The drainage ditches, which at times carried plant effluent, flow to the north and northeast from the pond and filtration areas. The plant was constructed in the 1940s. In 1979, DBCP and other organic substances were detected in the plant's effluent. A tertiary treatment plant was installed to extract the DBCP and other organics. These substances were also detected both in the sewage treatment pond and First Creek drainage. In addition, sludge from the Imhoff tanks has been placed in trenches approximately 200 feet southwest of the sewage treatment plant.

Groundwater depths range from zero to ten feet below the surface in this area. Boreholes are located in one of the trickling filters, at the points of outfall of the sewage treatment plant pond and tanks, and at junctures of



- ▲ APPROXIMATE LOCATION OF EXISTING BORING
- PROPOSED PHASE I BORING
- (5) PROPOSED BORING DEPTH (FEET)

FIGURE 3.3-8
PROPOSED BORING LOCATIONS
SEWAGE TREATMENT PLANT (24-6)

First Creek and the ditches to detect any source of contamination to First Creek. The pond will be sampled in six locations. Locations may change slightly depending on physical conditions at the times of sampling. All boreholes except one are expected to go only to five feet, due to the proximity of the water table to the surface.

<u>Number of Borings</u>	<u>Total Depth (ft)</u>	<u>Number of Soil Samples</u>
10	5	20

Total Number of Borings = 10

Total Number of Samples = 20

3.3.5.8 Site 30-4, Sanitary Landfill

The sanitary landfill has an area of 400,000 square feet. Figure 3.3-9 illustrates its setting and proposed borehole locations. The sanitary landfill was started in 1964 with a depth of 10 feet. Between 1975-80, it was relocated to the northwest and is still in use today. The landfill was used for the disposal of municipal wastes and refuse. Typical landfill leachates are expected to have infiltrated the soil at this site. In addition, from 1946-1951, nearby areas of Section 30 were used as an impact range for 4.2-inch mortars, and contaminants from these operations may be present in the vicinity of the site.

Groundwater levels vary from 15 to 20 feet below the surface at the landfill site.

Both the old and the new landfill sites will be sampled. A total of twelve borings will be made in Phase I.

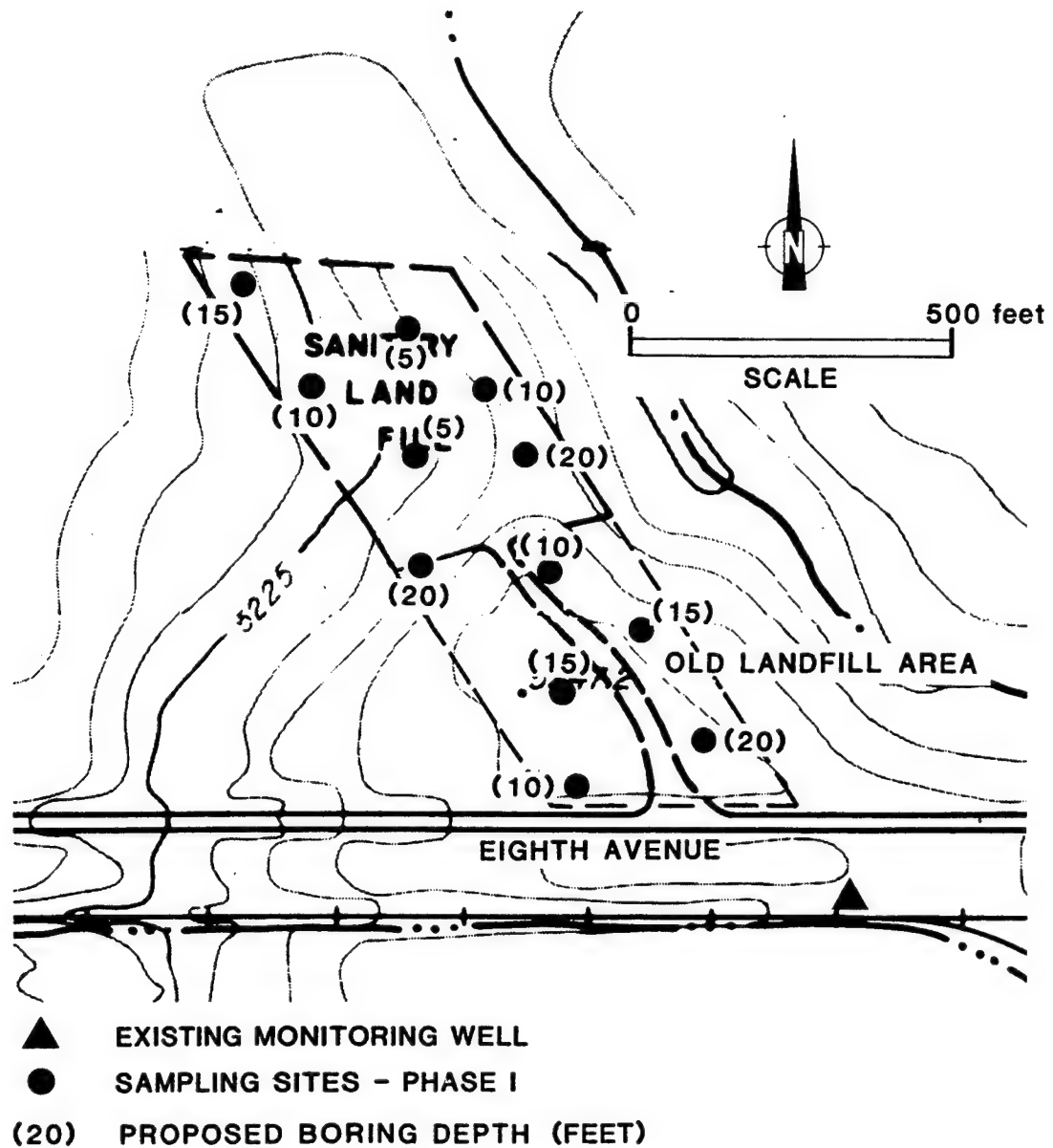


FIGURE 3.3-9
PROPOSED BORING LOCATIONS
SANITARY LANDFILL (30-4)

<u>Number of Phase I Borings</u>	<u>Total Depth (ft)</u>	<u>Number of Soil Samples</u>
3	20	15
2	15	8
4	10	12
3	5	6

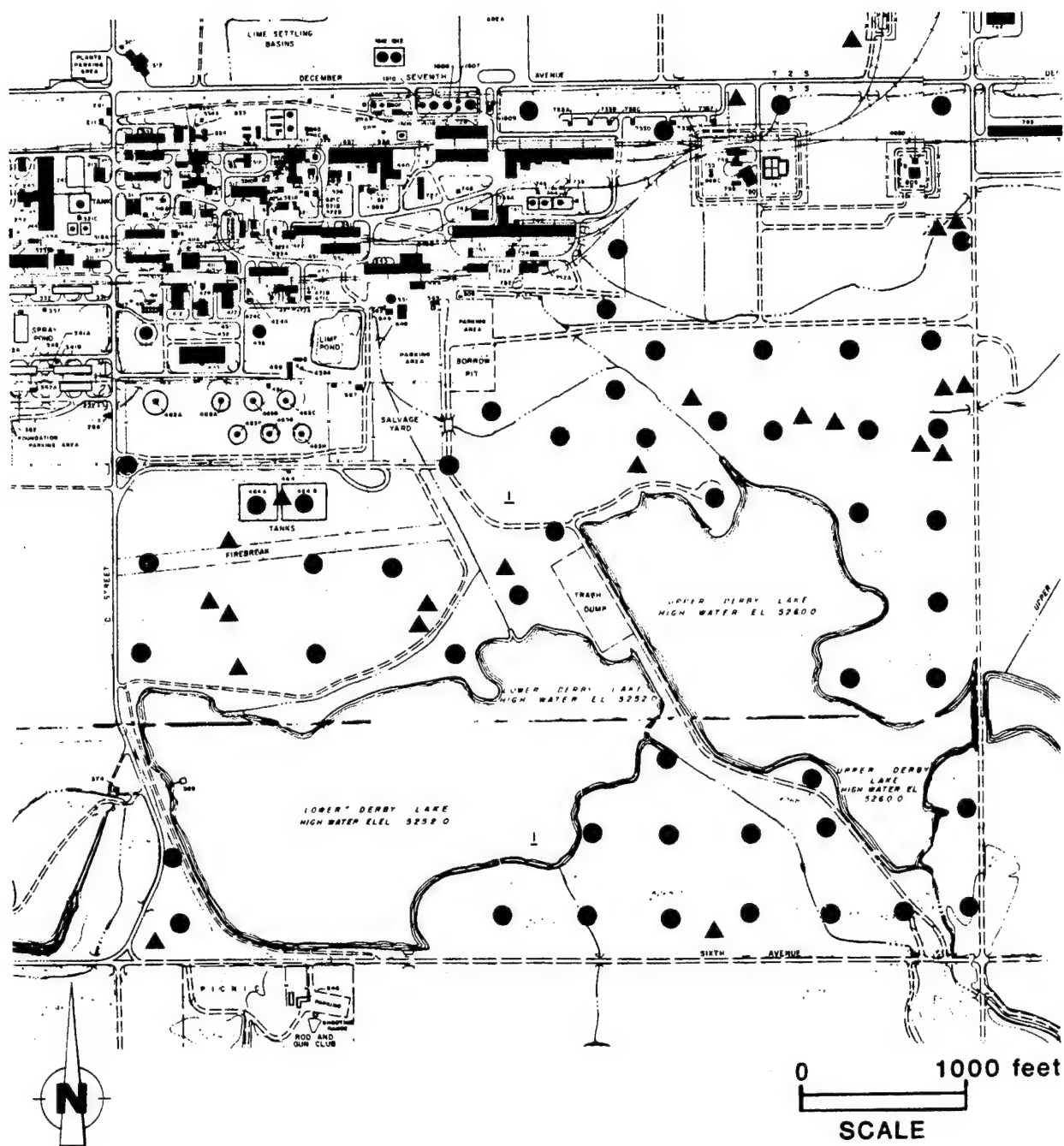
Total Number of Borings = 12

Total Number of Samples = 41

3.3.5.9 Section 1, Uncontaminated Area

The uncontaminated areas of Section 1 cover approximately 14,000,000 square feet. Figure 3.3-10 shows the setting and proposed borehole locations. No major contaminating occurrences were recorded at this site. Runoff from the South Plants area may have contaminated some of the soils here, as well as overflow from either Upper or Lower Derby Lake. However, no records of contaminated soil exist for this area.

The density of borings is one boring per 250,000 square feet. This figure was chosen based on the criteria described in Section 3.3.1. The area around South Plants and other sources is considered to be contaminated. Therefore a 500-foot boring spacing will be used for the uncontaminated areas. Borehole locations have been placed so that no sampling point falls on or close to an existing borehole. A total of 56 borings were originally proposed using the 1/250,000 square foot spacing policy for Phase I uncontaminated areas. However, only 55 borings are now proposed, since a boring from Task 2 was located very close to a proposed boring at Site 1-4. Due to the odd shape of some of these areas, the grid has been somewhat skewed to accommodate the samples. All borings will be to a depth of 5 feet. Soil samples from 0-1.0 feet and 4-5 feet will be composited for laboratory analysis.



- ▲ EXISTING BORINGS OR MONITORING WELLS
- PROPOSED BORING LOCATIONS
(ALL BORINGS WILL BE FIVE FEET DEEP)
- UNCONTAMINATED AREA

FIGURE 3.3-10
PROPOSED BORING LOCATIONS
UNCONTAMINATED AREA - SECTION 1

Number of Phase I
Borings

Total Depth
(ft)

Number of
Soil Samples

55

5

55

Total Number of Borings = 55

Total Number of Samples = 55

3.3.5.10 Section 2, Uncontaminated Area

The uncontaminated area of Section 2 covers approximately 19,000,000 square feet. Figure 3.3-11 illustrates the setting and proposed borehole locations. Little information is available about contaminants that may have reached this area, but it is surrounded by or encloses Ladora Lake and Lake Mary, drainage ditches, a lagoon, a tank area, a fire break, two ground scars, and two open storage areas. A part of South Plants is in the northeast portion of Section 2. Surface flow that drained from contaminated areas here may have contributed a small amount of contamination. Otherwise, the area is considered clean. Groundwater levels near the lakes range from 5 to 10 feet and near the southwest corner of Section 2 are approximately 15 feet below the surface.

As in Section 1, borings are spaced at approximately 500 foot intervals. Some skewing has been done to provide sampling of the railroad tracks for possible Nemagon spills. A total of 69 borings are proposed for this area. As in Section 1, all samples will be composited from 0-1.0 and 4 to 5 feet for laboratory analyses.

Number of Phase I
Borings

Total Depth
(ft)

Number of
Soil Samples

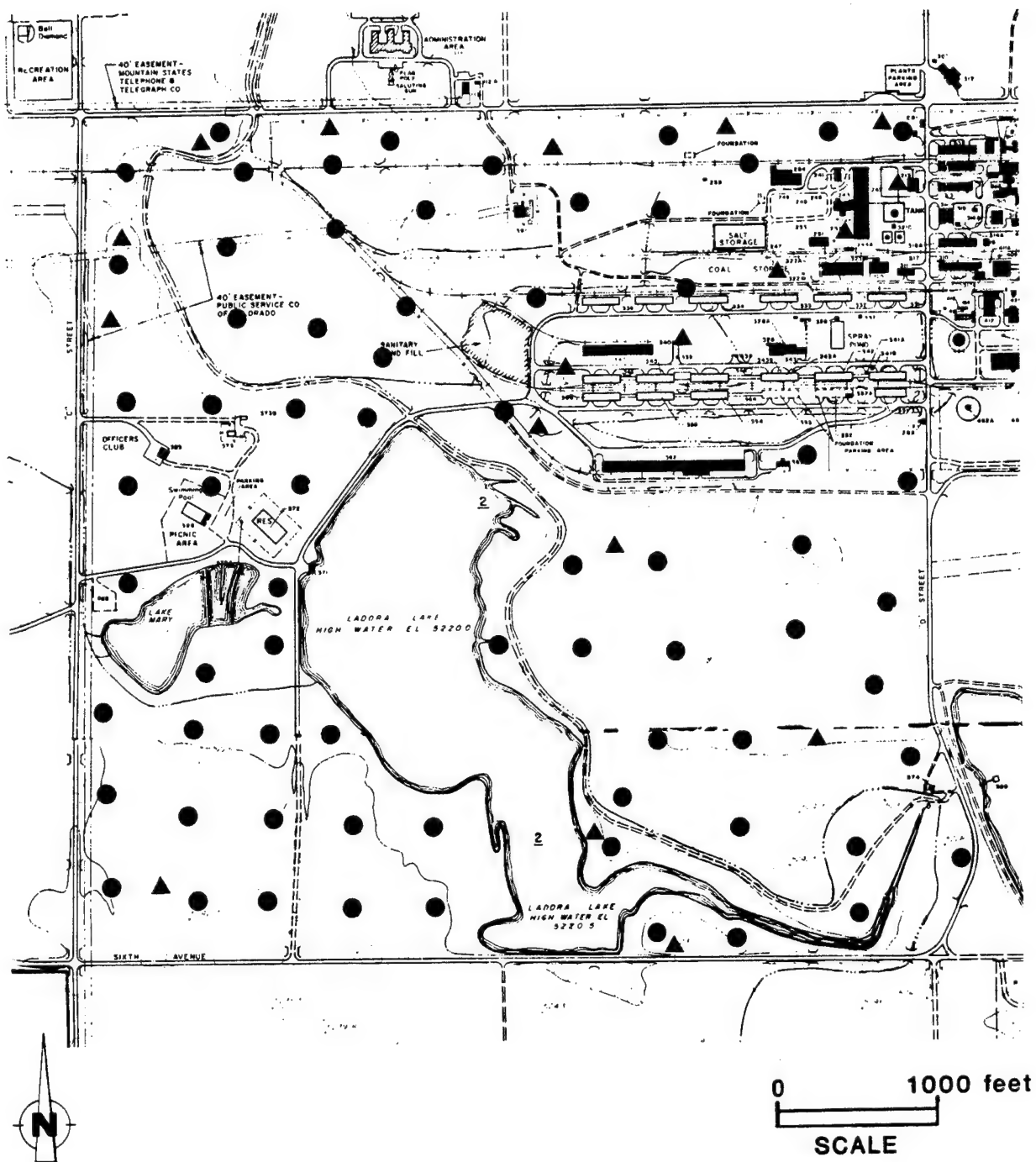
69

5

69

Total Number of Borings = 69

Total Number of Samples = 69



- ▲ EXISTING BOREHOLES OR MONITORING WELLS
 - PROPOSED PHASE I BOREHOLES
(ALL BORINGS WILL BE FIVE FEET DEEP)
- UNCONTAMINATED AREA

FIGURE 3.3-11
PROPOSED BORING LOCATIONS
UNCONTAMINATED AREAS - SECTION 2

Table 3.3-2 summarizes the number of borings and samples and sampling areas and densities for Phase I.

3.3.6 Evaluation of Phase I Soil Boring Data

The primary objectives of the Phase I soil sampling program are to determine if soil contamination exists and what the types of contaminants are. From these determinations, the locations of and depths of Phase II borings will be decided. In addition, the types of chemical analyses that will be carried out for the Phase II program will be designed.

After the soils and geologic data are collected and processed through the QA/QC and data management routines, as described in Sections 5.0 and 6.0, they will be evaluated. The chemical data will be integrated with the soils and geologic data as soon as it becomes available. With these data, the types and concentrations of contaminants present, estimates of the lateral and vertical extent of the contaminants and definition of contaminant boundaries will be determined.

Each source, spill, or ditch will be evaluated in a sequence linked to the field activities and schedule. For example, the first site where borings have been completed will be the first site analyzed. Phase I data from the first site will probably be analyzed four to six weeks after the drilling is completed. Therefore, the schedule of site evaluations can be derived from and linked to the field schedule.

TABLE 3.3-2

SUMMARY OF GEOTECHNICAL PROGRAM

Site Number	Site Name	PHASE I		Area (square feet)	Boring Spacing (feet)
		Number of Borings	Number of Samples		
1-1	Drainage Ditches	8	24	176,000	80
1-9	Open Storage Area	14	49	565,000	110
2-1	Drainage Ditches	15*	46	480,000	105
2-17	Lakes Ladora and Mary	21**	32	3,142,000	150
3-2 & 3-3	Drainage Ditch and Overflow Basin	8*	18	30,480	42
3-4'	Nemagon Spill Area	10	66	276,000	88
24-6	Sewage Treatment Plant	10	20	320,000	95
30-4	Sanitary Landfill	12	41	400,000	100
Section 1	Uncontaminated Areas	55	55	14,000,000	500***
Section 2	Uncontaminated Areas	69	69	19,000,000	500***

*Number of samples increased because of linear geometry of site.

**Number of samples reduced by 50% because of previous work performed by WES.

***See Section 3.3.2. Boring spacing averaged approximately 500 feet after considering proximities of uncontaminated areas to contaminated areas.

4.0 CHEMICAL ANALYSIS PROGRAM

4.1 Introduction

The chemical analysis program was designed to be consistent with the sampling program for Task 7. Analytical methods for this task are described in more detail below. The referenced analytical methods in this Technical Plan were those specified during meetings of the Analytical Services Teams for Tasks 1 and 2. These analytical methods identified in the Task 7 Technical Plan were divided between the four contractor laboratories for method development prior to the initiations of Task 2 field activities. Once a method was developed it was distributed to all laboratories in the program for certification. Certification has been completed under Task 2 for all methods.

Samples collected from the sources identified in Sections 1, 2, 3, 4, 24, and 30 will be screened for target analytes and unknown contaminants. Analytical methods, including desired analyte concentration, high range concentration, sample holding times, reference method and principle of method, are identified in Table 4.1-1.

Only soil and solid matrices (e.g., soil borings and sediments) will be sampled during Task 7. Soil and solid matrix samples will be assayed semiquantitatively by gas chromatography/mass spectroscopy (GC/MS) for volatile and semivolatile organic target analytes. An attempt will be made to identify other major unknown peaks present in the GC/MS total ion current profiles. Potential unknown analytes include those identified as: discarded commercial chemical products, off-specification species, container residues and spill residues thereof (40 CFR 261.33); and Appendix VIII Analytes (40 CFR 261) as amenable to the GC/MS methodology cited in this document. Collected samples will also be assayed quantitatively by gas chromatography (GC) for 1,2-dibromo-3-chloropropane (DBCP); by graphite furnace atomic absorptive spectroscopy for arsenic; by cold vapor atomic absorption spectroscopy for mercury; and for other target metals by inductively coupled argon plasma (ICP) emission spectroscopy. Additionally, selected RMA soils

TABLE 4.1-1
ANALYTICAL METHODS/SOLID MATRIX (SOIL, SOLIDS, SEDIMENT) FOR TASK 7

Analysis/Matrix/Analytes	Detection* Limit	High Range Concentration	Hold Time	Level of Certification	Reference Methods	Principle of Method
Volatile Organics/Solids			7 days for the solid and 30 days for the extract (1)	Semi- Quantitative (A)	EPA 624 (2) EPA 8240 with EPA 5030 extraction (1): USATHAMA Method N9 for UBTL and K9 for CAL	A 10 gram portion of the sample is obtained with a minimum of handling. The sample is shaken for 4 hours with 10 ml methanol. An aliquot of the methanol extract is injected into 5 ml of water and analyzed by purge-trap GC/MS using a packed column. Surrogates and internal standards are used. Unknowns are identified.
1,1-Dichloroethane	0.5 µg/g	25 µg/g				
Dichloromethane	0.5 µg/g	25 µg/g				
1,2-Dichloroethane	0.5 µg/g	25 µg/g				
1,1,1-Trichloroethane	0.5 µg/g	25 µg/g				
1,1,2-Trichloroethane	0.5 µg/g	25 µg/g				
Carbon tetrachloride	0.5 µg/g	25 µg/g				
Chloroform	0.5 µg/g	25 µg/g				
Tetrachloroethylene	0.5 µg/g	25 µg/g				
Trichloroethylene	0.5 µg/g	25 µg/g				
Trans-1,2-Dichloroethylene	0.5 µg/g	25 µg/g				
Benzene	0.5 µg/g	25 µg/g				
Toluene	0.5 µg/g	25 µg/g				
Xylene (3 isomers)	0.5 µg/g	25 µg/g				
Ethylbenzene	0.5 µg/g	25 µg/g				
Chlorobenzene	0.5 µg/g	25 µg/g				
Methylisobutyl ketone	0.5 µg/g	25 µg/g				
Dimethyldisulfide	0.5 µg/g	25 µg/g				
Bicycloheptadiene	0.5 µg/g	25 µg/g				
Dicyclopentadiene	0.5 µg/g	25 µg/g				
Semi-Volatile Organics/Solids			7 days for the solid & 30 days for the extract (1)	Semi- Quantitative (A)	EPA 8270 with EPA 3540 extraction (1): USATHAMA Method L9 for UBTL, X9 for CAL and X9-A for HEA	A 15 gram portion of the sample is obtained with a minimum of handling and mixed with 30 grams of anhydrous sodium sulfate. The sample is extracted for 8 hours in Soxhlet with 300 ml of methylene chloride. The extract is reduced to a final volume of 10 ml in a K-D apparatus. An aliquot of the extract is analyzed by fused silica capil- lary GC/MS. Surrogates and internal stan- dards are used. Unknowns are identified.
Aldrin	0.5 µg/g	100 µg/g				
Endrin	0.5 µg/g	100 µg/g				
Dieldrin	0.5 µg/g	100 µg/g				
Isodrin	0.5 µg/g	100 µg/g				
p,p'-DDT	0.5 µg/g	50 µg/g				
p,p'-DDE	0.5 µg/g	100 µg/g				
Chlorophenylmethyl sulfide	0.5 µg/g	100 µg/g				
Chlorophenylmethyl sulfoxide	0.5 µg/g	50 µg/g				
Chlorophenylmethyl sulfone	0.5 µg/g	100 µg/g				

Surrogates are:
d₂ - Methylene chloride
d₆ - Benzene
d₁₀ - Ethylbenzene

The internal standard will be
1,2-dibromoethane-d₄.

TABLE 4.1-1 (Continued)

Analysis/Matrix/Analytes	Detection* Limit	High Range Concentration	Hold Time	Level of Certification	Reference Methods	Principle of Method
Hexachlorocyclopentadiene	0.5 µg/g	100 µg/g				Surrogates are: d ₄ -1,3-Dichlorobenzene d ₄ -Diethylphthalate d ₄ -2-Chlorophenol d ₄ DI-n-Octyl Phthalate
Oxathiane	0.5 µg/g	100 µg/g				
Dithiane	0.5 µg/g	100 µg/g				
Malathion	0.5 µg/g	100 µg/g				
Parathion	0.5 µg/g	100 µg/g				
Chlordane	0.5 µg/g	100 µg/g				
Azodrin	0.5 µg/g	100 µg/g				
Vapona	0.5 µg/g	100 µg/g				
Supona	0.5 µg/g	100 µg/g				
DIMP	0.5 µg/g	50 µg/g				
Atrazine	0.5 µg/g	100 µg/g				
1,2-Dibromo-3-chloropropane/ Solids	0.01 µg/g	1.0 µg/g	7 days for the solid and 30 days for the extract See (1)	Quantitative (B)	Developed by MRI for USATHAMA Certification. USATHAMA Method S9 for UBTL and Z9 for CAL	A 10 gram portion of the sample is obtained with a minimum of handling. The sample is shaken with 20 ml of 50/50 hexane/acetone for 4 hours. The extract is rinsed with distilled water and analyzed by GC/ECD using a fused silica capillary column.
ICP Metal Screen/Solids			6 mos (3)	Quantitative (B)	USATHAMA Method P9 for UBTL and A9 for CAL	A 1 gram portion is digested with 3 ml repeated portions of HNO ₃ and finished with HCl. The sample is filtered to a final volume of 50 ml. The sample is analyzed by ICP.
Cadmium	0.5 µg/g	500 µg/g				
Chromium	5 µg/g	500 µg/g				
Copper	5 µg/g	500 µg/g				
Lead	5 µg/g	500 µg/g				
Zinc	5 µg/g	500 µg/g				
Aluminum	Interelement Correction	Interelement Correction				
Iron	Interelement Correction	Interelement Correction				
Arsenic/Solids	1 µg/g	10 µg/g	6 mos	Quantitative (B)	EPA 7060 with EPA 3050 extraction (2): USATHAMA Method B9 for UBTL and G9 for CAL	A one gram portion of the sample is digested with H ₂ O ₂ + HNO ₃ . The digest is analyzed by GF/AA.

TABLE 4-1 (Continued)

Analysis/Matrix/Analytes	Desired Detection Limit	High Range Concentration	Hold Time	Level of Certification	Reference Methods	Principle of Method
Mercury/Solids	0.1 ug/g	1 ug/g	28 days (3)	Quantitative (B)	EPA 245.5 (3)	A one gram portion is weighed out and treated with aqua regia followed by potassium permanganate. Excess permanganate is reduced with hydroxylamine sulfate. The mercury is reduced with stannous chloride and determined using the cold vapor technique.
Organics Screen/Air-Charcoal	-	-	4 weeks in freezer	None	UBTL method developed for NIOSH	The front and back sections of the charcoal tubes are combined and extracted with 1 ml of methylene chloride. The extract is analyzed by GC/MS using a fused silica capillary column. Significant unknowns are identified.
Organics Screen/Air-Tenax	-	-	4 weeks in freezer	None	UBTL method developed for NIOSH	The front and back sections of the Tenax tubes are combined and extracted with 1 ml of isooctane. The extract is analyzed by GC/MS using a fused silica capillary column. Significant unknowns are identified.
Organic Material/Solids	0.1%	99.9%	None	None	UBTL Method (4)	A sample of soil is dichromate oxidized with heat in 10 ml 0.5 N $K_2Cr_2O_7$ and 15 ml conc. H_2SO_4 . Sample is cooled, diluted with deionized water to 60 ml and titrated to endpoint with 0.2 N ferrous ammonium sulfate hexahydrate with N-Phenylanthranilic acid as indicator.

References:

- (1) SW-846, 2nd ed., July 1982.
- (2) EPA-600/4-82-057, July 1982 Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater.
- (3) EPA-600/4-79-020, Revised March 1983 Methods for Chemical Analysis of Water and Wastes.
- (4) Methods of Soil Analysis, Part 2: Chemical and Microbiological Properties-Agronomy Monograph No. 9, 2nd Edition. Published by the American Society of Agronomy, Inc. Madison, Wisconsin, 1965. Sixth Printing 1983.

Notes:

- (A) Semi-Quantitative: See the RMA Procedures Manual, Volume II, Section 11.2.2.1.
- (B) Quantitative: See the RMA Procedures Manual, Volume II, Section 11.2.2.2.
- (*) Actual detection limits for Certified Methods are identified in the RMA procedures Manual (Volume IV Project Specific Analytical Methods Manual) for each laboratory. Detection limits for uncertified methods and methods to be certified are desired detection limits.

will also be assayed for total soil organic matter. Sample shipping and holding temperatures are indicated in the QA/QC plan and the Procedures Manual. Matrix samples will be assayed for analyte profiles identified in Table 4.1-2. Analytical methods for worker exposure (e.g., volatile organics in air) will not be PMO Certified. Data from these samples will be used as an initial assessment and to identify the potential for worker exposure to organic vapors. A summary of laboratory analyses indicating preservation guidelines, analytical methods required, level of certifications, total analytical requirements, and weekly laboratory rates of analysis is given in Volume II of the RMA Procedures Manual (Ebasco 1985b).

4.2 Sample Matrices

All soil, sludge, sediment and solid matrices were considered as soils for analytical purposes. Prior to sample collection, all soil and solid analytical methods had been PMO certified on a representative soil. This representative soil was a background soil collected from the RMA area. Data for soil and solid matrices were initially reported on a dry weight basis and may be converted to a wet weight basis as required by the PMO.

4.3 Summary of Task 7 Analytical Methods

This section briefly describes the analytical methods for target analytes and their detection limits in the Task 7 survey. Table 4.1-1 summarizes each analytical method. PMO certified analytical methods for Task 7 are described in the order of occurrence shown in Table 4.1-1. The noncertified Phase I method for volatile organics in air follows the certified methods described, as shown in Table 4.1-1. Lastly, a noncertified method for organic materials in soil is described. The specific protocol for each method may be reviewed in Volume IV: Project Specific Analytical Methods Manual, RMA Procedures Manual (Ebasco, 1985b).

TABLE 4.1-2

MATRIX SAMPLE ANALYSIS BY ANALYTE PROFILE

MATRIX SAMPLES				
	Surface Soils With Apparent Oil Contamination	Surface Soils Without Apparent Oil Contamination	Subsurface Soils	Lake Bottom Sediments
Volatile Organics	+	-	+	+
Semivolatile Organics	+	+	+	+
1,2-Dibromo-3- Chloropropane	+	-	+	+
Arsenic	+	+	+	+
Mercury	+	+	+	+
Moisture	+	+	+	+
Organic Matter	+	+	+	+

+ analyses will be completed.

- analyses will not be completed.

4.3.1 Volatile Organics in Soil and Solid Samples by Gas Chromatography/Mass Spectrometry (GC/MS)

The volatile organics method in solids was based on EPA Method 8240 (EPA SW-846). This method was PMO certified for soils and solids at the semiquantitative level for the Task 7 Program.

Due to their volatility, analysis for these compounds will be restricted to deep soils or surface soils contaminated with oil. A volatile organics analysis will be performed on oil contaminated surface soils because of the possibility that contaminating oils may trap volatiles in these soils. Surface soils not contaminated with oil will not be assayed for volatile organics by this technique.

In this method, a 10 gram portion of the sample will be obtained with minimum of handling and placed into 10 ml methanol in a volatile organic acid (VOA) septum vial, spiked with the surrogates: methylene chloride- d_2 ; benzene- d_6 ; and ethyl benzene- d_{10} , capped with a Teflon lined lid and shaken for four hours. A 20 μ g aliquot of the methanol extract will be removed, spiked with 200 μ g of 1,2-dibromoethane- d_4 as an internal standard and injected into 5 ml of organics-free water contained in a syringe. The contents of the syringe will then be injected into a purging device, purged and analyzed on a packed column (1% SP-1000 on Carbopack B) by GC/MS. Each sample will be assayed for target compounds at detection limits identified in Table 4.1-1.

4.3.2 Semivolatile Organics in Soil and Solid Samples by Gas Chromatography/Mass Spectrometry (GC/MS)

This analytical technique was based on EPA Method 8270 in solids (EPA SW-846) and was PMO certified in soils and solids at the semiquantitative level.

Using this method, a 15 gram portion of the sample will be obtained with a minimum of handling and spiked with the surrogates: 1,3-dichloro-benzene- d_4 ; diethylphthalate- d_4 ; 2-chlorophenol- d_4 ; and di-n-octylphthalate- d_4 . The sample will be mixed with anhydrous sodium sulfate (30 grams or more depending on

sample moisture content) then Soxhlet extracted for 8 hours with 300 ml methylene chloride. The extract is reduced to a final volume of 10 ml in a Kuderna-Danish (K-D) apparatus. An aliquot of this concentrate will be spiked with phenanthrene- d_{10} as an internal standard and analysed on a fused silica capillary column by GC/MS. Samples will be assayed for target analytes at the detection limits shown in Table 4.1-1.

4.3.3 Metals in Soil and Solid Samples by Inductively Coupled Argon Plasma (ICP) Emission Spectrometry

The ICP method, based on PMO Method 7S, is PMO certified at the quantitative level. In this procedure, a 1 gram portion of sample will be digested in a watch glass covered Griffin beaker with 3 ml of concentrated nitric acid. Contents of the beaker will be heated to near dryness and repeated portions of concentrated nitric acid added until the sample is completely digested. The digestion process is finished with 2 ml of 1:1 nitric acid and 2 ml of 1:1 hydrochloric acid. The sample digest will be filtered, the beaker and watch glass rinsed with deionized water and rinsate passed through the filter. The digestate is brought to a final volume of 50 ml and assayed by ICP. Samples will be assayed for target metals at detection limits identified in Table 4.1-1.

4.3.4 Arsenic in Soil and Solid Samples by Graphite Furnace Atomic Absorption (AA) Spectroscopy

The arsenic method in soils and solids was developed from EPA Method 7060 (EPA-SW-846). Using this method, a one gram sample will be digested with hydrogen peroxide and concentrated nitric acid. The digest will be filtered and assayed by graphite furnace atomic absorption spectroscopy. The detection limit for arsenic is 1 $\mu\text{g/g}$. This method was PMO certified at the quantitative level.

4.3.5 Mercury in Soil and Solid Samples by Cold Vapor Atomic Absorption (CVAA) Spectroscopy

This mercury method, developed from EPA Method 245.5 (EPA 600/4-82-057), was PMO certified at the quantitative level. In the method, a one gram sample portion will be digested with aqua regia followed by treatment with potassium permanganate. Excess permanganate will be reduced with hydroxylamine sulfate. Mercury is reduced with stannous chloride and assayed by cold vapor AA. The detection limit for mercury is 0.1 µg/g.

4.3.6 1,2-Dibromo-3-chloropropane (DBCP) in Soil and Solid Samples by Gas Chromatography (GC)

This method, used to assay for DBCP, is based on a method developed by Midwest Research Institute and is PMO certified at the quantitative level.

Using this procedure, a ten gram portion of the sample will be obtained with minimum handling and shaken for 4 hours with 20 ml of hexane/acetone (1:1) mixture. The extract will be rinsed with distilled water, brought to a final volume of 10 ml with hexane and assayed by a GC equipped with an electron capture detector and using a fused silica capillary column. The detection limit for this compound is 0.01 µg/g as identified in Table 4.1-1.

4.3.7 Volatile Organic Compounds in Air Using Activated Charcoal and Tenax

This method was designed by UBTL for the National Institute of Occupational Safety and Health. It is designated for use in this program as a screening tool to identify the potential for each sampling team's exposure to volatile organic contaminants in air during the Task 7 program. The charcoal is desorbed with methylene chloride, and Tenax with isooctane. Extracts will be analyzed by packed column or fused silica capillary column GC/MS in order to identify significant unknown compounds. This method will not be PMO certified. (See Volume IV of the RMA Procedures Manual for method).

4.3.8 Organic Materials in Soil Samples

The organic materials in soil method was developed by UBTL for use in their agricultural soils analytical program. The procedure is derived from Methods in Soils Analysis, Part 2 (American Society of Agronomy 1965). In this method, a sample of <100-mesh soil will be weighed into an Erlenmyer flask, exactly 10 ml 0.5 N potassium dichromate solution and 15 ml concentrated sulfuric acid added.

The flask is connected to a West condenser and heated to dichromate oxidize all organic matter. The flask will then be cooled and the condenser rinsed with deionized water. Contents of the flask will be brought to a 60 ml volume with deionized water and titrated with a 0.2 N ferrous ammonium sulfate hexahydrate solution using N-phenylanthranilic acid as indicator. Concentrations of organic matter in soil ranging from 0.1 to 99.9 percent may be detected by this procedure. This method will not be PMO certified. (See Volume IV of the RMA Procedures Manual for method).

4.3.9 Unknown Identification in Soil, Solid, and Liquid Samples by Gas Chromatography/Mass Spectrometry (GC/MS)

The total ion current profile will be screened for all major unknown peaks. The laboratories will report (RT [Retention Time] Code, estimated concentrations and print MS [Mass Spectral] traces) all unknowns with peaks greater than 10 percent of the internal standard response (excluding obviously meaningless peaks, e.g., column bleeds) will be reported as the purity, fit and probability to match the three most likely candidate compounds from the Environmental Protection Agency/National Bureau of Standards/National Institute of Health (EPA/NBS/NIH) Mass Spectral library computer program.

5.0 . QUALITY ASSURANCE PROGRAM

5.1 Project QA Plan

An integral part of the Technical Plan is the project specific Quality Assurance (QA) Plan describing the application of Ebasco's procedures to monitor and control field and analytical efforts at RMA. Ebasco has developed a Project QA Plan applicable to geotechnical, sampling and analytical activities. For Task 7 Ebasco will adhere to and comply with the established QA requirements. The plan is presented in Volume II of the RMA Procedures Manual. The specific objectives of the Ebasco Quality Assurance Plan for RMA are to:

- o Ensure adherence to established PMO QA Program guidelines and standards;
- o Ensure precision and accuracy for measurement data;
- o Ensure validity of procedures and systems used to achieve project goals;
- o Ensure that documentation is verified and complete;
- o Ensure that deficiencies affecting quality of data are quickly determined;
- o Perform corrective actions that are approved and properly documented;
- o Ensure that the data acquired will be sufficiently documented to be legally defensible;
- o Ensure that the precision and accuracy levels attained during the PMO analytical certification program are maintained during the project.

The overall project QA responsibility rests with the Project Quality Assurance Coordinator. He will be assisted by the Field and Laboratory QA/QC Coordinators. Each field sampling team will include a Field QA/QC Coordinator. The Field QA/QC Coordinator for each team will assure that all quality control procedures are implemented for drilling, sampling, chain-of-custody and documentation.

Ebasco is using two laboratories for the performance of chemical analytical services. Both laboratories will comply with the Project QA Plan. Each laboratory has appointed a Laboratory QA/QC Coordinator. Their responsibilities include:

- o Monitor the quality control activities of the laboratory;
- o Recommend improvement in laboratory quality control protocol, when necessary;
- o Log in samples, introduce control samples in the sample train and establish sample testing lot sizes;
- o Approve all data before submission to permanent storage;
- o Maintain all quality control records and chain-of-custody documents;
- o Assure document and sample security;
- o Inform Ebasco's Project Quality Assurance Coordinator of non-compliance with the Project QA Plan; and
- o Prepare and submit a weekly report of quality control data to the Ebasco Project Quality Assurance Coordinator.

Prior to actual field program, a QA/QC training will be conducted by the Project Quality Assurance Coordinator to indoctrinate field, laboratory and project personnel in the specific procedures detailed in the Project QA Plan.

Also, prior to analysis of samples, the Project Quality Assurance Coordinator will visit the laboratories to review analytical procedures with chemical analysis personnel and instruct the Laboratory QA/QC Coordinators in the requirements of the Project QA Plan and data validation procedures. In addition, the Project Quality Assurance Coordinator will perform audits of field and laboratory work on a bi-monthly basis to ensure compliance with the Project QA Plan. Specific project QA/QC requirements are described in the following sections.

5.2 Specific Project Requirements

5.2.1 Geotechnical Requirements

The project geotechnical requirements are described in Section 7 of the Project QA Plan (Volume II of the RMA Procedures Manual). These requirements are based on the geotechnical guidelines established by PMO. Specifically, this chapter addresses the geotechnical requirements for well drilling operations, borehole logging, well installation and development, well diagrams, well acceptance, topographic surveying, selected data management entries and geotechnical reports. Ebasco will have a geologist present and responsible at each operating drill rig for logging samples and monitoring of drilling operations.

5.2.2 Field Sampling

The management of samples, up through the point of shipment from the field to the laboratory, will be under the supervision of Ebasco's Field QA/QC Coordinators. Samples must be collected in properly cleaned containers, properly labeled, preserved and transported according to the prescribed methods. Section 8.0 of the Project QA Plan describes the procedures to monitor adherence to approved sampling protocol. If the Field QA/QC Coordinator determines that deviations from the sampling protocol have occurred, resulting in a compromise of the sample integrity, all samples taken prior to the inspection will be discarded and fresh samples will be taken. The Field QA/QC Coordinator is responsible for field chain-of-custody

documentation and transfer and will supervise the strict adherence to chain-of-custody procedures.

5.2.3 Laboratory Quality Assurance Procedures

Section 10 of the Project QA Plan describes the Laboratory Quality Assurance Procedures. Both laboratories along with their internal quality assurance program will adhere to the Project QA Plan.

The Laboratory QA Program begins with the receipt of the samples from the field. All samples will be shipped to UBTL for logging in, sample splitting and distribution for analyses. The Laboratory QA/QC Coordinator is responsible for monitoring the laboratory activities. He is also responsible for determining testing lot sizes and introducing laboratory control samples into the testing lot.

The samples must be analyzed within the prescribed holding time by the approved analytical methods. Analytical methods are described in Section 4.0 of the Technical Plan.

5.2.4 Laboratory Analytical Controls

Daily quality control of the analytical systems ensures accurate and reproducible results. Careful calibration and the introduction of the control samples are prerequisites for obtaining accurate and reliable results. Procedures for instrument calibration and analytical controls are described in Section 12 of the Project QA Plan.

The laboratory coordinator for each laboratory will monitor the analytical controls. The out-of-control situation can be detected by the control charts.

When an out-of-control situation is detected, efforts will be initiated to determine the cause. Corrective actions will be taken to bring the process under control. Full documentation of an out-of-control situation and the

subsequent corrective action will be recorded by the Laboratory QA/QC Coordinator.

5.2.5 Laboratory Data Management, Data Review and Validation and Reporting Procedures

Sections 13 to 16 of the Project QA Plan detail the procedures for laboratory data review, validation and reporting procedures. The laboratories utilize highly automated system for analytical data collection and reduction. The analytical supervisor along with the Laboratory QA/QC Coordinator review all analytical data after data reduction and prior to the transfer of the data report to Ebasco. The laboratory data reporting procedure is described in Section 15 of the Project QA Plan which is based on the established PMO reporting procedures for analyses performed at quantitative and semi-quantitative levels. The laboratories will adhere to this reporting procedures.

6.0 DATA MANAGEMENT PROGRAM

6.1 Plan Overview

This plan presents the data management procedures to be used by Ebasco for the Environmental Program at Rocky Mountain Arsenal. As specified in the contract, all data will be presented to PMO in appropriate format and entered into the IR-DMS UNIVAC 1100/60. PMO has provided a Tektronix 4051 system and IR Data Management User's Guide, Version 85.6 (PMO, 1984) to Ebasco for this purpose. Data will be controlled as necessary. Presentation of project management data and report communication is discussed in Ebasco's Management Plan.

Figure 6.1-1 shows schematically the process Ebasco will use to coordinate data management activities between itself and UBTL, Inc. (UBTL), California Analytical Laboratories (CAL), and Installation Restoration-Data Management Systems (IR-DMS). This is detailed in Section 6.3. As shown in Figure 6.1-1, Ebasco's primary data entry terminal for the IR-DMS will be through the Army-owned Tektronix terminal in Ebasco's Denver office. A second Army-owned terminal is maintained in Ebasco's Santa Ana office for backup data entry purposes. Specifics of data collection, data entry, data validation, and data analysis are discussed herein.

6.2 Field Activities

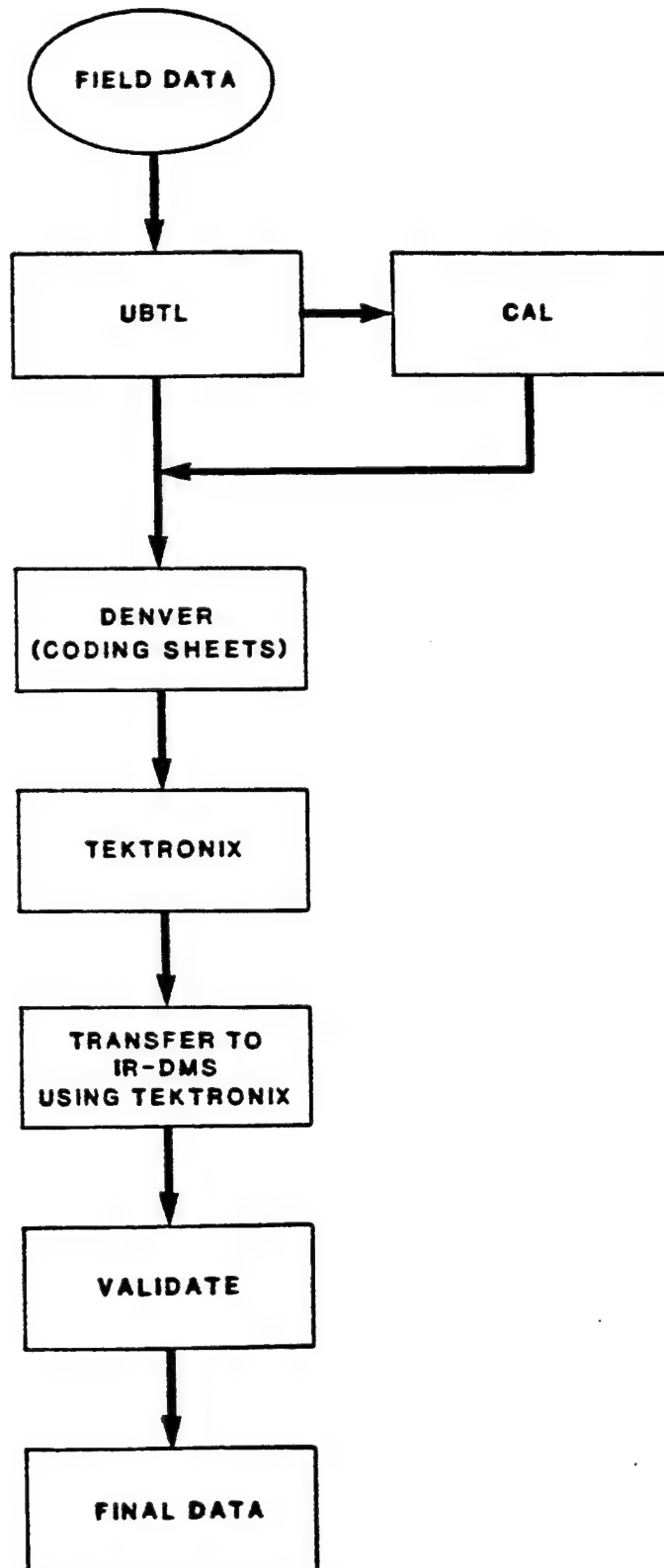
6.2.1 Sample Handling

The Sample Coordinator is responsible for field data collection and logging of the sampling program. In addition, the Sample Coordinator will assure that all field data are properly accounted for and transferred to the Data Manager for input into the computer at Ebasco's Denver office.

To accomplish this, the Sample Coordinator will assure that proper sample collection procedures, sample control identification procedures and proper

FIGURE 6.1-1

DATA FLOW BETWEEN EBASCO, UBTL, CAL AND IR-DMS



chain-of-custody procedures are followed. (Specific procedures and reporting forms to be used for the management of field data are detailed in Appendix A of Volume II of the RMA Procedures Manual).

Sample control identification numbers will be assigned by the Sample Coordinator to each sample collected in the field. These sample identifiers will be recorded on the sample tag in the field data log book and on the sample chain-of-custody record at the time of sample collection. The chain-of-custody record will also serve as the analytical request form, verifiable by the analytical request list on the sample tag. The Sample Coordinator will check sample tags, chain-of-custody forms and field data logs to assure complete and correct field data entry. Field identification numbers will remain with each sample throughout the data collection, shipment, analysis and report phases of the program.

As part of the logging in of field data, the Sample Coordinator will copy each chain-of-custody form onto the field notebook, package and seal the samples for shipment to the laboratory and assure the shipment of these samples. The Sample Coordinator will forward the necessary written field records to the Data Manager at Ebasco's Denver office for entry into the computer.

6.2.2 Geotechnical Program

Geotechnical boring logs, containing pertinent data regarding borehole lithology, will be coded immediately upon receipt from the field onto PMO data coding sheets. These data will be entered into the Geotechnical Field Drilling (GFD) Files at the Ebasco Denver office.

Upon completion of the drilling of borings at each site, a surveying crew will determine map coordinates and ground elevations for each boring. These survey data will be coded immediately onto PMO data coding sheets, and will be entered into the IR-DMS Map Files at the Ebasco Denver office. These files will be entered into the data management system before the completion of chemical analyses, as each sample location must be associated with a map location.

6.2.3 Laboratory

When samples are received at UBTL, the Sample Receipt Officer will sign the chain of custody record, log in sample shipment, verify sample integrity, assign sample lots, prepare split samples and identify samples to be sent to CAL or to be retained by UBTL for chemical analysis. Each laboratory, UBTL and CAL, will submit weekly sample status reports to Ebasco's Data Manager. This weekly status report will be used to aid in planning the rate of field sampling and the distribution of laboratory workloads.

Field and laboratory sample control identification and chemical analysis data will be transcribed to the data coding sheet by UBTL and CAL, then verified using the program's laboratory control procedures. The verified data coding sheets will then be delivered, by courier, to Ebasco's Data Manager for entry into the IR-DMS data base.

6.3 Data Entry and Validation

The first step in data entry into the IR-DMS Univac 1100/60 will be to create a magnetic tape copy of the coding sheets on the Tektronix 4051 terminal by keypunching. The Tektronix operator will enter only a subset of a complete file at one time. These file subsets will later be merged to a single file using the UNIVAC. After keypunching, the operator will obtain a printed copy of the data subset using the Tektronix printer, and will verify that the data in the Tektronix tape file is identical to that on the coding sheets. The operator will correct any data entry typographic errors using the Tektronix editor, then obtain a second printing of the file to confirm that the changes were properly made. Methods certification data and map location data will be entered first because validation routines make use of it.

Once the operator is certain that there are no remaining data entry errors on the Tektronix tape, the operator will use the Tektronix 4051 as a remote terminal to transfer the data to the UNIVAC 1100/60. To do this, the operator will load the data entry software, catalog a Level 1 (pre-acceptance) file on the UNIVAC, and transmit the data over the telephone lines using a

modulator-demodulator (modem). Ebasco's operators will transfer Tektronix entry tape files to Level 1 UNIVAC files at least once per week, and will maintain a log of terminal usage and communication with the UNIVAC.

Once data is transferred, the operator will make use of IR-DMS utilities provided to convert English units of measurement to International Standard (SI) units. State Planar or Universal Transverse Mercator (UTM) grid system coordinates will also be converted to local origin coordinates, if necessary.

Next, the operator will invoke the IR-DMS data acceptance routines to perform the final data verification and create a Level 2 (temporary read-only) file. The acceptance routines will identify any errors in format or coding and any inconsistencies with corresponding map records previously loaded. If the acceptance routine does find errors at this stage, the operator will check the "R" file. The "R" file contains the rejected records that the acceptance routine creates. The UNIVAC editor is used to correct the verified entries, then they are resubmitted to the UNIVAC for acceptance. After acceptance, the IR-DMS automatically creates chemical and geological Level 2 files. Ebasco's operators will run the Level 1 data files through the data acceptance routines within seven days of their transfer to the UNIVAC system. They will delete Level 1 files once these data are accepted at Level 2.

Once the Level 2 file is created, the data processing operator will create a printed copy of the data set on the UNIVAC 1100/60 and submit, within ten working days of the Level 2 transfer, this copy to PMO.

The final step in the data entry and validation process, the creation of a Level 3 (final version, read-only) file, is undertaken by the PMO APG-EA data processing staff.

6.4 Analysis and Presentation

Ebasco scientists will access the PMO IR data base and will perform analyses as required to support all contamination assessment work. The data analysis efforts may include graphic representations of data using data gridding,

contouring, and three-dimensional surface representations. (Specifics of the contamination assessment work are presented in Section 8.)

Several techniques will be used to access the data. If possible, IBM PCs will be used in terminal emulation mode to capture Level 3 data from the IR data base in order to perform analyses and prepare material for presentation. The Tektronix 4051 terminals in Denver and Santa Ana will also be used in a direct link to the UNIVAC to prepare analyses and graphic representations. Ebasco scientists may establish communication links between IBM PCs to interchange data and facilitate data analysis.

7.0 HEALTH AND SAFETY PROGRAM

A draft of the project Health and Safety Plan (HASP), prepared according to the Ebasco Corporate Health and Safety Program, is included in Volume III of the RMA Procedures Manual. The purpose of this section is to provide an overview of the safety program that Ebasco will employ to ensure the safety of its employees and that of subcontractors engaged in the field investigation activities at RMA. All personnel working at RMA are familiar with this document and they have been indoctrinated in all aspects of the safety program.

In particular, the following specifics of this document are especially important to the South Plants Area investigative activities. These are:

- o Safety organization, administration and responsibilities;
- o Initial assessment and procedures for hazard assessment;
- o Safety training;
- o Safety operations procedures;
- o Monitoring procedures;
- o Safety considerations for sampling; and
- o Emergency procedures.

Overall responsibility for safety during the site investigation activities rests with the Project Health and Safety Officer. He is responsible for developing the site-specific HASP at RMA and through the on-site Health and Safety Coordinator assumes its implementation responsibility. Specifically, he and his staff are responsible for:

- o Characterizing the potential specific chemical and physical hazards to be encountered;
- o Developing all safety procedures and operation on-site;
- o Assuring that adequate and appropriate safety training and equipment are available for project personnel;

- o Arranging for medical examinations for specified project personnel;
- o Arranging for the availability of on-site emergency medical care and first aid, as necessary;
- o Determining and posting locations and routes to site work zones;
- o Notifying installation emergency officers (i.e., police and fire departments) of the nature of the team's operations and making emergency telephone numbers available to all team members;
- o Indoctrinating all team members in safety procedures.

In implementing this safety program, the project Health and Safety Officer will be assisted by an on-site Health and Safety Coordinator. His function is to oversee that the established health and safety procedures are properly followed. The details of the safety organization, administration and responsibilities are described in Section I of this HASP.

Based on the evaluation of past activities, incidents and, accidents and investigations, the presence of chemicals and wastes were found to be present randomly throughout the the area that will be investigated under Task 7. The characteristics of these waste are known to be toxic and hazardous to the human health. The conclusion on the site hazard assessment based on historical evidence is that the overall site hazard assessment is extremely variable and is entirely location and operation dependent. Section V of the HASP describes the procedures to be employed to determine hazard of a specific building or a sampling location for the identification of the preliminary level of protection requirement.

Section VI of the HASP explains the training program that is planned for the RMA project. Basically, the training will focus on the general health and safety consideration and provide site specific safety instructions.

Section VII describes in detail the safety operations procedures. The important aspects of the safety operations procedures are:

- o Zone approach for field work;
- o Personal protection; and
- o Communications.

A three zone approach (Support Zone, Contamination Reduction Zone and Exclusion Zone), where possible, will be utilized for field work at RMA. The Support Zone will contain the Command Post with appropriate facilities such as communications, first aid, safety equipment, support personnel, hygiene facilities, etc. This zone will be manned at all times when field team are operating downrange. Adjacent to the Support Zone will be the Contamination Reduction Zone (CRZ) which will contain the contamination reduction corridor for the decontamination of equipment and personnel (the actual decontamination procedures are discussed in Section X of the HASP). All areas beyond the CRZ will be considered the Exclusion Zone. For well drilling or soil boring operations the Exclusion Zone will be established as a 30 foot radius from the drill rig. These support facilities are discussed and illustrated in Section III of the HASP.

The level of protection to be worn by field personnel will be defined and controlled by the on-site Health and Safety Coordinator and will be specifically defined for each operation in an information sheet (Facility Information Sheet). The preliminary Facility Information Sheet (FIS) will be developed based upon historical information and data. This will be upgraded and utilized for future operations based upon the results of the Health and Safety portion of the soil sampling programs. For these programs, Level C type protection will generally be provided for investigation team members, however, Level D type protection may also be utilized as appropriate based on assessment by the Health and Safety Officer and the on-site Health and Safety Coordinator. If determined necessary, changing from Level C to B protection can be easily achieved in the field. This can be accomplished in a matter of hours. Basic level of protection (i.e., Levels A, B, C or D) for general operations are defined in Section VII.

Maintaining proper communications among team members (investigation team and Health and Safety team members) during field investigation work is of utmost

importance for the protection of investigation team members. The methods of communication that will be employed are:

- o Walkie Talkies;
- o Air Horns;
- o Hand Signal;
- o Voice Amplification System.

For external communication telephones and sirens will be utilized.

Section VIII of the HASP explains the health and safety monitoring procedures. A continuous monitoring of the working environment will be performed to ensure the adequacy of the level of personnel protection. Depending on the history of the sampling location the presence of the following parameters will be monitored:

- o Army Agents;
- o Oxygen Level;
- o Explosive Conditions;
- o Organic Vapors Level;
- o Inorganic Gases Level;
- o Dust Analyses.

The type of on-site monitoring instruments to be utilized includes but is not limited to the following and will be based on the potential for the instrument specific contaminants to be present:

- o M18A2 Chemical Agent Kit for Army Agents;
- o M8 Alarm for nerve agent;
- o Oxygen meter for oxygen level;
- o Combustible gas indicator for explosive condition;
- o PID and FID meters for organic vapors; and
- o For inorganic gases, a gold film mercury monitor, a chlorine monitor, a carbon monoxide monitor and a hydrogen sulfide monitor.

Based on the monitoring results (real time and field or laboratory analyses of the health and safety samples) the on-site Health and Safety Coordinator can stop field investigation work or upgrade and/or downgrade the level of personal protection.

Section IX of the HASP explains the safety considerations during actual sampling event. It describes the safety procedures to be followed for drilling operations, soil, surface water and liquid waste sampling, building sampling, and sampling in a confined space.

The emergency procedures are described in Section XII to XIV of the HASP. Section XII explains the basic emergency scenarios and activities to be undertaken during each of these emergency situations; Section XIII describes how to get emergency services (i.e. medical, fire protection, ambulance, etc.) and Section XIV outlines the evacuation procedures in case of emergency such as fire, explosion, and/or a significant release of toxic gases.

SECTION 8

8.0 CONTAMINATION ASSESSMENT

The objectives of the Contaminant Assessment Program of which Task 7 is the Phase I component are to quantify the contaminants present, assess the extent of contamination, evaluate the factors that govern contaminant distribution within potentially uncontaminated areas in Sections 1 and 2 and contaminated areas in Sections 3, 4, 24, 30 and 33, determine the severity and significance of the contamination, and develop a Phase II program, if necessary. As stated above, Task 7 consists only of the Phase I studies for the subject study areas. In Phase I, investigations will be conducted at each potential source area to evaluate whether the sites are contaminated, and if so, the types of compounds and metals present at each site. The Phase I studies will be accomplished through a limited number of borings from which samples will be screened for pollutants. The results of the Phase I investigations will be utilized to define the extent of studies required in Phase II. Phase II studies are presently planned to be part of a separate task. In order to accomplish objectives of the overall program, the contamination assessment in Phases I and II will consist of the following subtasks:

1. Determination of the type, magnitude, distribution, and extent of contamination
2. Examination of the geologic and hydrogeologic influence on the spatial distribution of contaminants
3. Estimation of the significance of soil contamination (criteria development)

8.1 Type, Magnitude, Distribution, and Extent of Contamination

The results of the soil boring analyses will be examined to determine the presence, quantities and extent of contamination within the Task 7 areas. Compilation of soil-contaminant data by source, location and depth will provide examination of the areal and vertical extent of contamination. The chemical data will be integrated with the soils and geohydrologic data as

described in Section 8.2. From this information, the types and concentrations of contaminants present, estimates of the lateral and vertical extent of the contaminants and definition of contaminant boundaries will be evaluated.

The data obtained during Phase I of Task 7 sampling will be used to determine the requirements for additional borings. Maps and cross-sections will be prepared to illustrate the spatial distribution and to delineate the existence of distinct contaminant concentration gradients in the proximity of sources and within the overall study areas.

8.2 Factors Influencing Contaminant Distribution and Mobilization

8.2.1 Geologic and Hydrologic Conditions

The hydrological data will be analyzed in conjunction with the historical information to determine the influence of the subsurface geology and hydrology in the distribution of contaminants in the ambient soils within the study areas.

Borehole logs of both cuttings and cores will be compiled, integrated, and interpreted to formulate a site-specific evaluation of geologic conditions. In addition to soil logs, geophysical borehole logging (gamma and neutron logs) in the groundwater monitoring wells will be examined. These data will be used to complete the understanding of subsurface geology.

Hydrogeologic conditions of the Task 7 areas will be assessed following the evaluation of previously generated hydrogeologic data and data collected during this investigation. The groundwater flow and direction within the Task 7 areas will be estimated.

8.2.2 Contaminant Properties and Geochemistry of Ambient Soils

The distribution and mobilization of contaminants are functions of both the molecular characteristics of the target chemicals and the physical/chemical properties of the soils. These variables will be examined, as applied to the

contaminants of concern and soil characteristics observed during drilling, and used in the data analyses to evaluate the contribution of these factors to the observed gradients.

8.3 Relationship of Contamination Sources to Past and Present Soil Contamination

The analysis of the contamination sources and soils data will be used to identify relationships between ambient soil and source contamination. These methods will allow for an estimate of the spatial extent of contamination and define the areas which may require cleanup. In addition, these analyses will identify the need for additional soil borings (increase in sampling density and change of grid configuration) to better delineate the contamination boundaries.

8.4 Significance of Soil Contamination (Criteria Development)

Action levels for the target chemicals are currently being developed by U.S. Army Medical Bioengineering Research and Development Laboratory (USAMBRDL) in coordination with the "How Clean is Clean" Committee. The approach being used is the Preliminary Pollution Limit Values (PPLV) method applied to five contaminant transport pathways consistent with the proposed land use scenarios. The pathways are: 1) drinking of groundwater, 2) inhalation of soil particles (dust), 3) soil ingestion by children, 4) ingestion of vegetables, and 5) uptake by fish and wildlife.

To date, physical/chemical and toxicological summaries of 55 target chemicals have been prepared by USAMBRDL and are currently being reviewed by the members of the "How Clean is Clean" Committee together with the overall PPLV methodology.

APPENDIX A

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